Preliminary Stormwater Management Report

Gladstone Crossing
Maplewood, Minnesota

May 23, 2023

Project No. 23-29050

ISG
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Engineering
Environmental
Planning
ISGInc.com

REPORT FOR:
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SIGNATURE SHEET

I HEREBY CERTIFY THAT THESE CALCULATIONS WERE PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

_____

Amanda Thomas, **P.E.**
Project Engineer
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Gladstone Crossing
Maplewood, Minnesota

Engineer's Project Number: 23-29050

Dated this 23rd day of May 2023

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APPENDICES

INTRODUCTION

This stormwater management report was prepared to facilitate the construction of a 40-unit affordable housing facility in Maplewood, Minnesota. The project site is located at 1373 Frost Avenue, between Clarence Street and Ide Street. The project property is 1.22 acres in area and the project will disturb approximately 1.30 acres. The proposed improvements include grading, underground utility installation, and the construction of the building, curb and gutter, underground detention system, and pavement surfacing.

In concurrence with the production of site plans, hydrologic and hydraulic models were developed to generate the data presented within this report. Given that the project will disturb more than one acre of land, a NPDES Construction Stormwater Permit will be required. This project is also subject to the City of Maplewood and Ramsey-Washington Metro Watershed District's (RWMWD) stormwater rate control and water quality requirements.

DRAINAGE CONDITIONS

Existing Site Conditions

The existing property consists of a parking area and vacant building totaling 0.50 acres in impervious area. The total drainage area is 1.22 acres. There are three existing drainage areas that discharge to City-owned storm sewer along Clarence Street, Frost Avenue, and Ide Street via overland drainage paths. Discharge to Clarence Street ultimately flows to a City-owned basin located between Curve Street North and Clarence Street. The basin discharges to City-owned stormwater facilities in Gloster Park. Similarly, runoff to Ide Street is collected and conveyed to storm sewer along Frost Avenue before discharging to Gloster Park. Stormwater facilities in Gloster Park ultimately discharge to Round Lake and Lake Phalen. The existing drainage areas are outlined in Table 1 below. An Existing Conditions Drainage Map is available in **Appendix A**.

Table 1. Existing Drainage Areas

Drainage Area	Total Area [ac]	Impervious Area [ac]	Pervious Area [ac]	Discharge Point
EX-1	0.74	0.36	0.38	West (Clarence St)
EX-2	0.15	0.04	0.11	South (Frost Ave)
EX-3	0.33	0.10	0.23	East (Ide St)
Total	**1.22**	**0.50**	**0.72**	-

Proposed Site Conditions

The proposed project will include the construction of a 40-unit apartment building, underground and surface parking areas, play area, access drive, and sidewalk. The project will result in a net increase in impervious area of 0.27 acres, totaling 0.77 acres of impervious area. An underground detention system is proposed beneath the surface parking area to provide stormwater detention and rate control for runoff from the building and parking areas. Existing drainage patterns have been maintained to the maximum extent practicable, and as such, the underground system is proposed to discharge to a City-owned catch basin in Clarence Street. Table 2 below summarizes the characteristics of each proposed drainage area. A Proposed Conditions Drainage Map is located in **Appendix A**.

Table 2. Proposed Drainage Areas

Drainage Area	Total Area [ac]	Impervious Area [ac]	Pervious Area [ac]	Discharge Point
DA-1	0.42	0.12	0.30	West (Clarence St)
DA-2	0.08	0.00	0.08	South (Frost Ave)
DA-3	0.09	0.03	0.06	East (Ide St)
DA-4	0.63	0.62	0.01	ADS Underground System
Total	**1.22**	**0.77**	**0.45**	-

Soil Conditions

A geotechnical evaluation including soil borings has not yet been performed for the site. Soils were preliminarily analyzed using the NRCS Web Soil Survey. Existing soils were found to be Urban Land with Chetek Complex, which contains loamy sands. The site was modeled using Hydraulic Soil Group (HSG) B soils and an MPCA generated infiltration rate of 0.3 inches per hour. The results of the NRCS Web Soil Survey are available in **Appendix B**.

STORMWATER MANAGEMENT

Stormwater Regulations

The location of the project involves three agencies with stormwater requirements: the Minnesota Pollutant Control Agency (MPCA NPDES Construction Stormwater Permit), the Ramsey-Washington Metro Watershed District, and the City of Maplewood. The project exceeds all agencies' disturbance thresholds, and as such, must meet all applicable stormwater rate control and water quality requirements as detailed below in Table 3. The RWMWD and City of Maplewood's requirements are more stringent than the MPCA requirements; thus, meeting the RWMWD and City of Maplewood's requirements indicates the site inherently complies with MPCA standards.

Table 3. Design Criteria

Agency	Performance Standard	Design Criteria
Minnesota Pollution Control Agency (MPCA) Construction Stormwater NPDES Permit	Sec. 15.3-15.4 - Volume Control	Volume reduction should be provided for the runoff from a one-inch rainfall across the additional impervious
	Sec. 16.6 - Pretreatment	A pretreatment device must be employed prior to discharging to a(n) (in)filtration BMP
	Sec. 16.7 - Water Quality Volume	BMPs must provide storage below the outlet for the instantaneous volume from one inch of rainfall across the impervious surfaces
	Sec. 16.8 - (In)filtration Drawdown	(In)filtration systems must discharge all water within 48 hours
	Sec. 16.12 - Groundwater Separation	Ensure a minimum of three feet of separation from the bottom of the BMP to the seasonally high groundwater table
Ramsey-Washington Metro Watershed District Rules	Rule C.3.b - Runoff Rate	Runoff rates for the proposed activity shall not exceed existing rates for the 2-, 10-, and 100-year critical storm events
	Rule C.3.c - Runoff Volume	Stormwater runoff shall be retained in the amount equivalent to 1.1 inches of runoff across new and reconstructed impervious areas. Volume reduction credit shall not exceed the volume of 2.5 inches over the impervious surfaces draining to the BMP
	Rule C.3.c.1.vi - Drawdown	Infiltration systems shall be capable of infiltrating within 48 hours
	Rule C.3.c.1.ix - Pretreatment	Pretreatment is required prior to discharging to infiltration areas
Maplewood Stormwater Management Standards	MSMS §1.b - Disturbance Threshold	Water quality and rate control requirements apply to projects which result in one-half acre of disturbance or 5,000 SF or more of new impervious surface
	MSMS §2.a.1 - Infiltration & Volume Control	A runoff volume of 1.1 inches across impervious surfaces must be treated via infiltration
	MSMS §3.a - Rate Control	Discharge rates must not exceed current rates for the 2-, 10-, and 100-year 24-hour storm events
	MSMS §4.e - Storm Sewer Design	Storm sewer shall be designed for a 10-year storm event using the Rational Method
	MSMS §4.h - Freeboard	The lowest floor elevation shall be at least 2 feet above the 100-year HWL and 1 foot above the EOF
	MSMS §5.c - Drawdown	Infiltration practices must be designed to draw down within 48 hours. The maximum ponding depth shall be 2 feet
	MSMS §5.d - Pretreatment	Infiltration practices require pretreatment for runoff; "clean" runoff may not require pretreatment at the discretion of the City

Stormwater Management System Overview

The rate control and water quality standards will be met by via an ADS underground detention system consisting of 112 SC-740 chambers. Stormwater from the underground parking ramp will be conveyed to the underground system using a pump. Stormwater will be pretreated by sumps in the structures directly upstream of the underground system. The system will discharge to a catch basin in Clarence Street via an 8" orifice and weir wall. During storm events larger than the 100-year event, stormwater will discharge the site via an emergency overflow route through the access drive.

Since infiltration testing and soil borings have not been performed, the system was model using an MPCA infiltration rate of 0.3 inches per hour for HSG B soils. The maximum proposed ponding depth (before accessing the outlet orifice) is 1.2 feet, ensuring the 48-hour drawdown time is met. The groundwater table elevation is unknown, but adequate separation will be ensured once additional soil information is available.

The proposed system was modeled in HydroCAD to determine how the project meets the applicable rate control standards. Hydrologic and hydraulic calculations were performed using the rainfall depths obtained from the City of Maplewood Stormwater

Management Standards and the MSE-3 24-hour rainfall distribution curve. The notable system elevations and high-water levels (HWL) for each storm event are summarized in Table 4 below. The complete Existing and Proposed Conditions HydroCAD reports are available in **Appendices C and D**, respectively.

Table 4. System Elevations + HWL Summary

	ADS System
Bottom of Stone [ft]	896.45
Orifice [ft]	897.65
Top of Weir Wall [ft]	899.75
Top of Stone [ft]	899.95
2-Year 24-Hour Storm HWL [ft]	897.84
10-Year 24-Hour Storm HWL [ft]	898.21
100-Year 24-Hour Storm HWL [ft]	899.57

Freeboard

The City of Maplewood requires that two feet of freeboard be provided between the 100-year high-water level and lowest floor elevation (LFE). The City also requires that one foot of freeboard be provided between the emergency overflow (EOF) route and LFE. The proposed building finished floor elevation (FFE) is 904, placing the bottom of the underground parking garage and lowest floor elevation at 893. Given that all adjacent City-owned storm sewer inverts are above 894.41, the freeboard requirements are unable to be met. Additionally, the building cannot be raised enough to provide the required freeboard due to grading constraints generated by the proposed pedestrian access routes along the south and east sides of the property. To resolve the grading restrictions in these areas, the building would need to exceed the maximum height restriction.

To prevent the underground system high-water level from impacting the building, a two-foot-thick impermeable clay liner has been provided between the building and system. Additionally, 4.43 feet of freeboard are provided between the 100-year HWL and building FFE. Two feet of freeboard are provided between the system HWL and EOF route. A ridge at an elevation of 903 feet is proposed between the access drive and underground parking ramp, providing one foot of freeboard from the EOF route to ensure the system does not backflow into the parking ramp.

Stormwater Rate Control

The RWMWD and City of Maplewood require that the proposed peak discharge rates do not exceed the existing peak discharge rates for the 2-, 10-, and 100-year 24-hour rainfall events. A summary of the existing and proposed peak discharge rates is available in Table 5. The peak discharge rates decrease from existing conditions for each storm event.

Table 5. Rate Control Analysis

Storm Event	Existing Peak Discharge [cfs]	Proposed Peak Discharge [cfs]
2-Year Storm (2.9”)	1.44	0.50
10-Year Storm (4.3”)	3.04	1.66
100-Year Storm (7.5”)	7.14	5.41

Water Quality

Both the RWMWD and City of Maplewood require that 1.1 inches of runoff across impervious surfaces be retained, exceeding the one-inch required by the MPCA. The water quality volume has been provided in the underground detention system. Additionally, a maximum of 2.5” across the impervious area draining to the BMP may be credited as volume reduction. The maximum available

credit exceeds the required and provided water quality volumes, ensuring the volume reduction requirement is adequately met by the underground system. The required and provided treatment volumes are summarized below in Table 6.

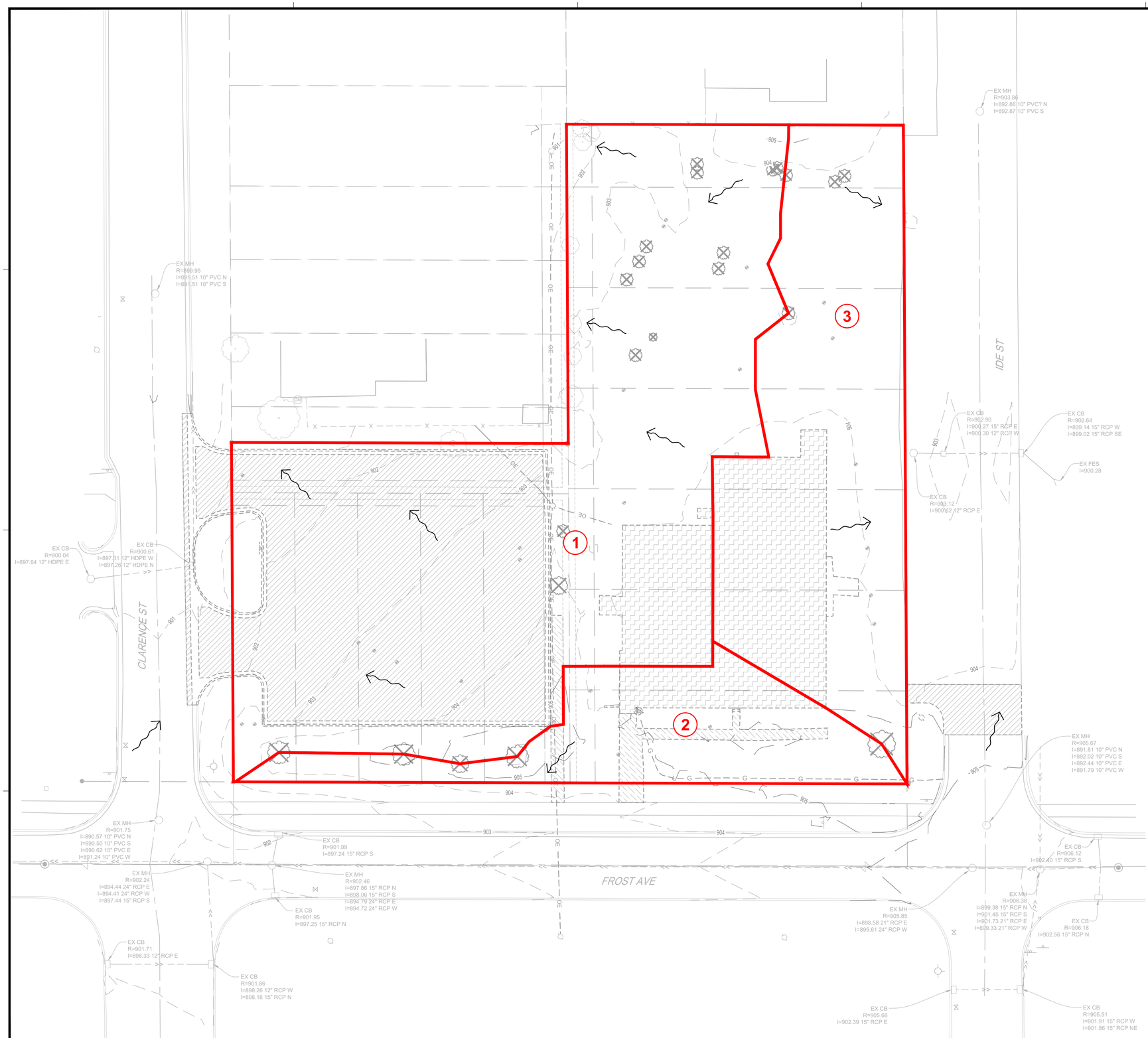
Table 6. Water Quality Volume

Required Water Quality Volume [cf]	3,069
Maximum Water Quality Volume [cf]	5,656
Provided Water Quality Volume [cf]	3,161

CONCLUSION

The proposed project will provide a stormwater management system that meets all MPCA, RWMWD, and City of Maplewood stormwater standards. The NPDES Construction Stormwater Permit will be applied for prior to any land disturbance activities. The proposed project as designed not only provides, but also exceeds the minimum rate control and water quality requirements.

Appendix A: Existing + Proposed Condition Drainage Maps



LEGEND

SYMBOL	DESCRIPTION
	EXISTING DRAINAGE ARROW
	PROPOSED DRAINAGE ARROW
101	EXISTING CONTOUR (MINOR INTERVAL)
100	EXISTING CONTOUR (MAJOR INTERVAL)
101	PROPOSED CONTOUR (MINOR INTERVAL)
100	PROPOSED CONTOUR (MAJOR INTERVAL)
1	DRAINAGE AREA DESIGNATION

EXISTING DRAINAGE AREAS

DRAINAGE AREA	TOTAL AREA [AC]	IMPERVIOUS AREA [AC]	PERVIOUS AREA [AC]
EX-1	0.74	0.36	0.38
EX-2	0.15	0.04	0.11
DA-3	0.33	0.10	0.23
TOTAL	1.22	0.50	0.72

N

0 20 40

SCALE IN FEET

ISG

PROJECT

GLADSTONE CROSSING

MAPLEWOOD MINNESOTA

REVISION SCHEDULE

DATE	DESCRIPTION	BY

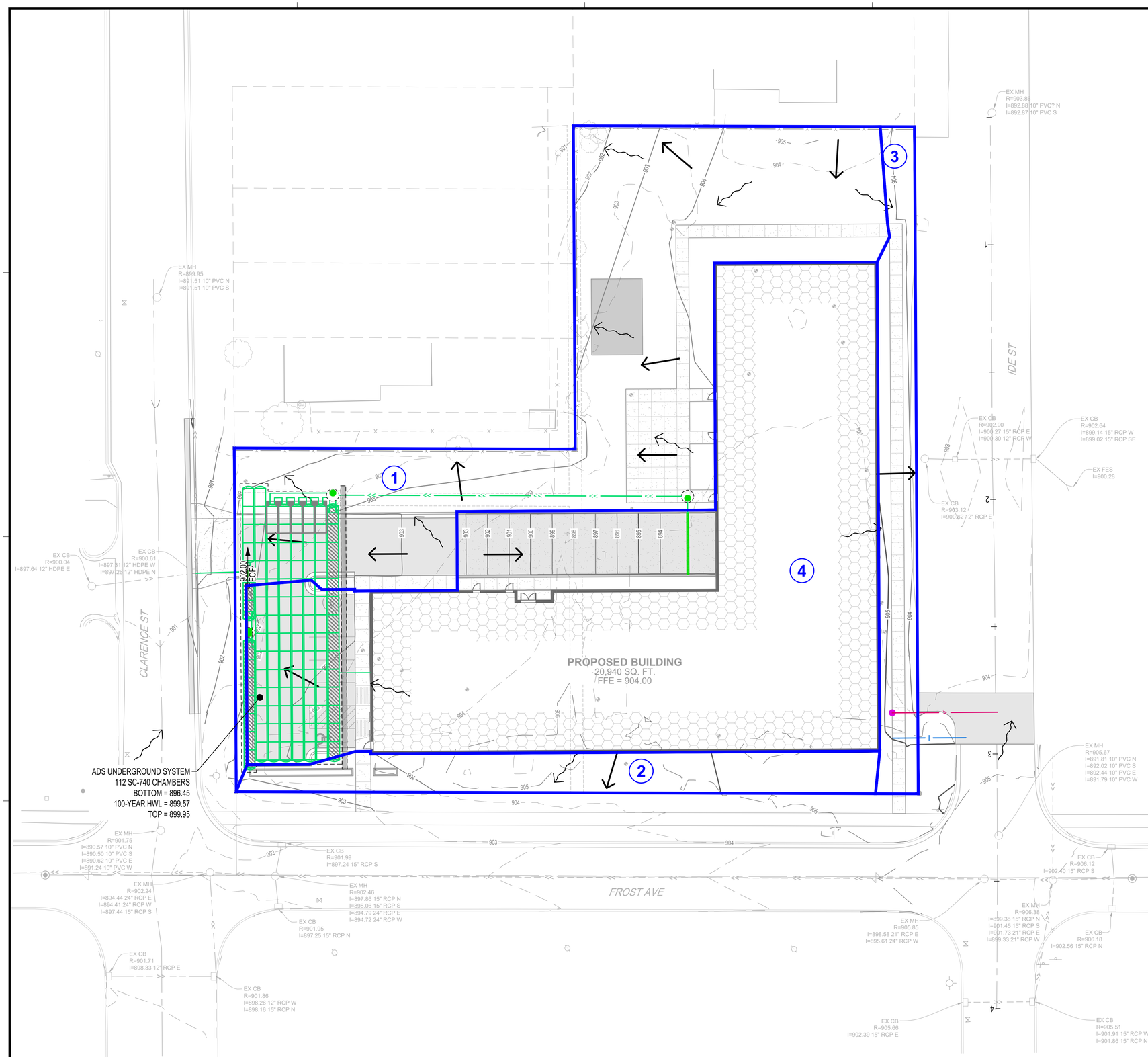
PROJECT NO.	29050
FILE NAME	29050 DRAINAGE AREAS
DRAWN BY	LCH
DESIGNED BY	LCH
REVIEWED BY	ART
ORIGINAL ISSUE DATE	--/--/--
CLIENT PROJECT NO.	-

TITLE

EXISTING CONDITIONS DRAINAGE MAP

SHEET

A1



LEGEND

SYMBOL	DESCRIPTION
	EXISTING DRAINAGE ARROW
	PROPOSED DRAINAGE ARROW
101	EXISTING CONTOUR (MINOR INTERVAL)
100	EXISTING CONTOUR (MAJOR INTERVAL)
101	PROPOSED CONTOUR (MINOR INTERVAL)
100	PROPOSED CONTOUR (MAJOR INTERVAL)
1	DRAINAGE AREA DESIGNATION

PROPOSED DRAINAGE AREAS

DRAINAGE AREA	TOTAL AREA [AC]	IMPERVIOUS AREA [AC]	PERVIOUS AREA [AC]
DA-1	0.42	0.12	0.30
DA-2	0.08	0.00	0.08
DA-3	0.09	0.03	0.06
DA-4	0.63	0.62	0.01
TOTAL	1.22	0.77	0.45

N

0 20 40

SCALE IN FEET

ISG

PROJECT

GLADSTONE CROSSING

MAPLEWOOD MINNESOTA

REVISION SCHEDULE

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PROJECT NO.	29050
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ORIGINAL ISSUE DATE	--/--/--
CLIENT PROJECT NO.	-

TITLE

PROPOSED CONDITIONS DRAINAGE MAP

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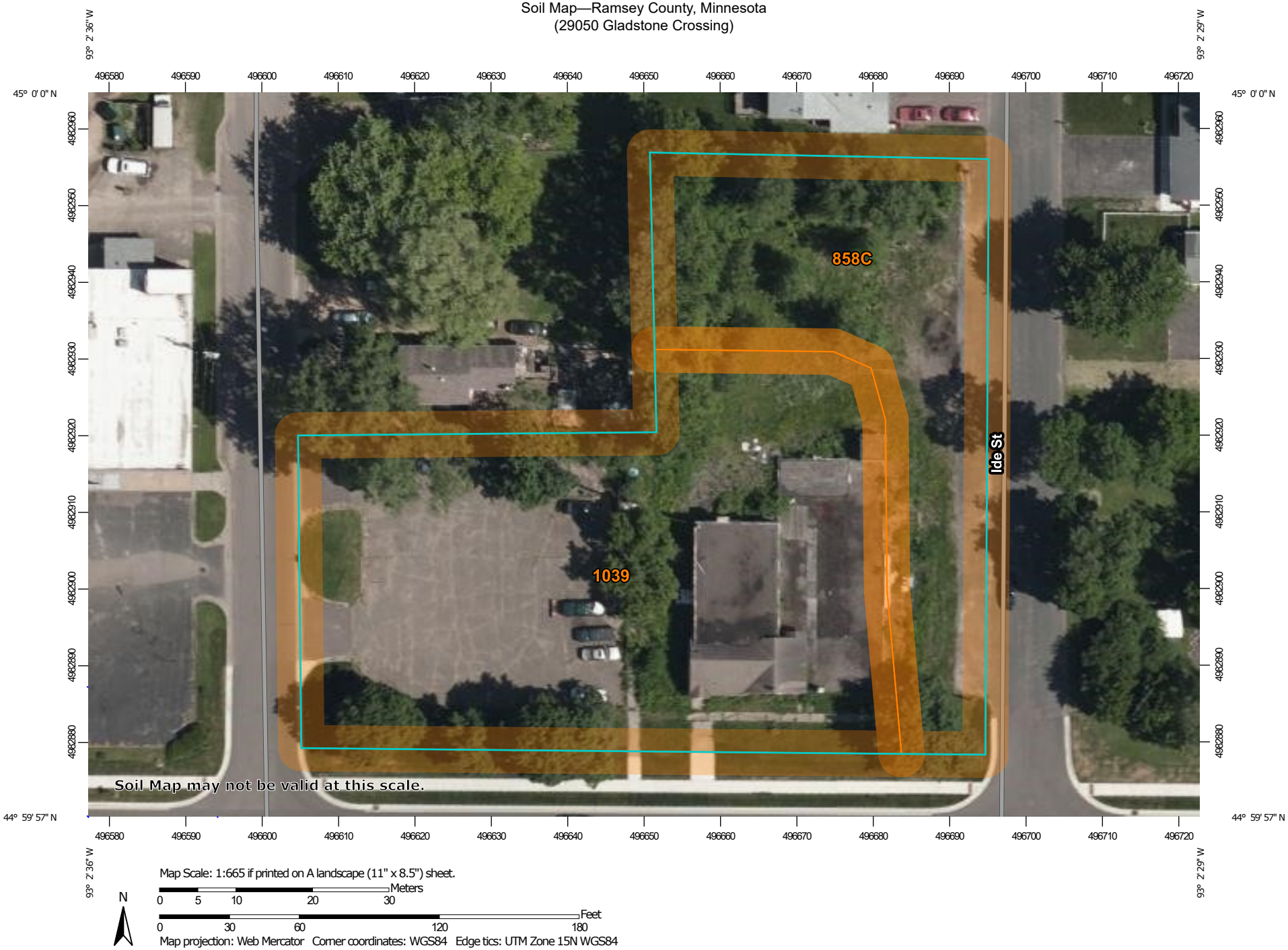
Appendix B: NRCS Web Soil Survey

Soil Map—Ramsey County, Minnesota
(29050 Gladstone Crossing)



Map Scale: 1:665 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 5 10 20 30

Feet
0 30 60 120 180

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Ramsey County, Minnesota
Survey Area Data: Version 17, Sep 6, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 3, 2020—Jun 12, 2020

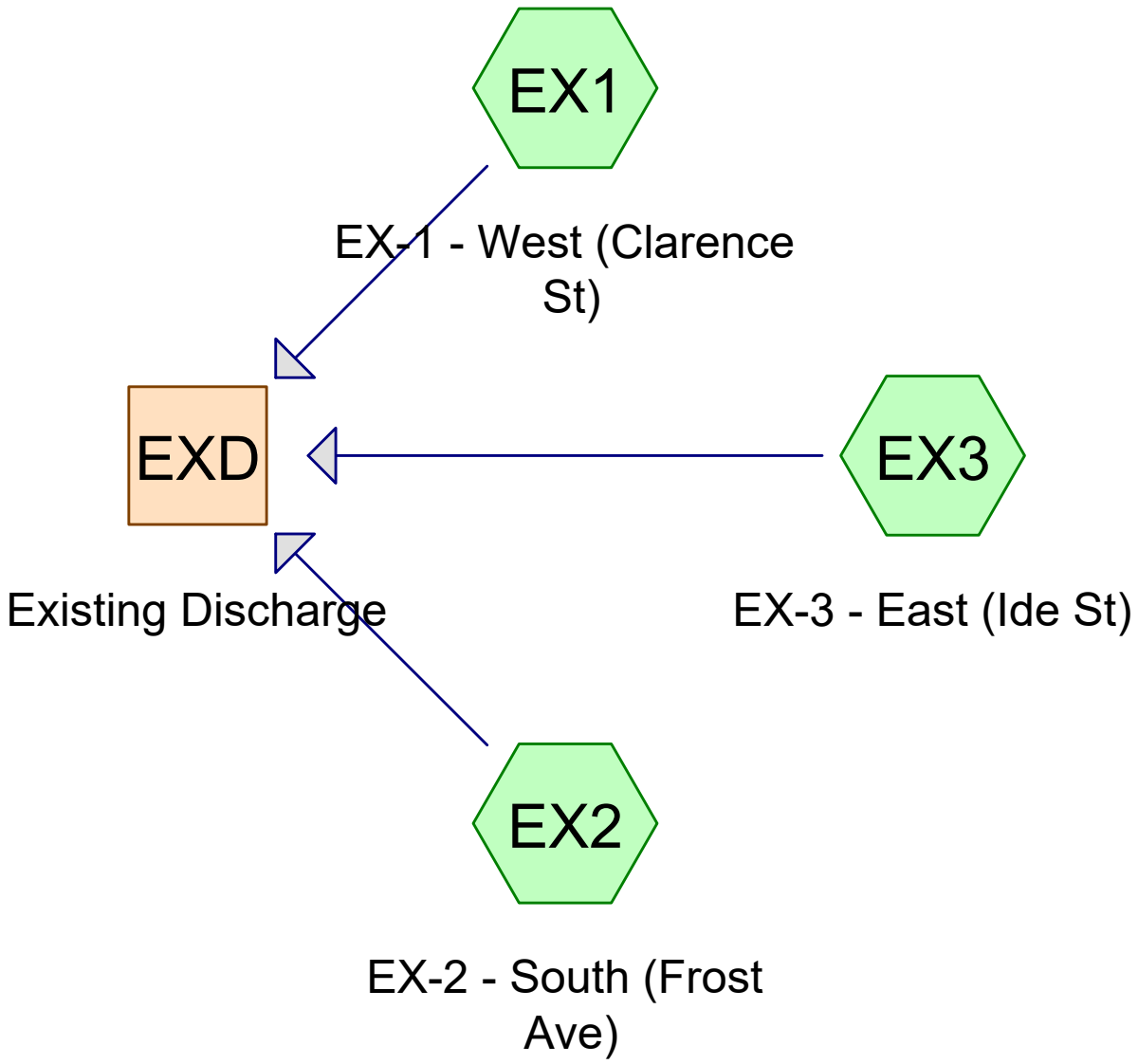
The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
858C	Urban land-Chetek complex, 3 to 15 percent slopes	0.4	33.9%
1039	Urban land	0.9	66.1%
Totals for Area of Interest		**1.3**	**100.0%**

Appendix C: Existing Conditions HydroCAD

EXISTING



Subcat Reach Pond Link

Routing Diagram for 29050 HydroCAD
Prepared by I&S Group, Inc, Printed 5/23/2023

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	MSE 24-hr	3	Default	24.00	1	2.90	2
2	10-Year	MSE 24-hr	3	Default	24.00	1	4.30	2
3	100-Year	MSE 24-hr	3	Default	24.00	1	7.50	2

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.724	61	>75% Grass cover, Good, HSG B (EX1, EX2, EX3)
0.497	98	Paved parking, HSG B (EX1, EX2, EX3)
1.221	**76**	**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment EX1: EX-1 - West (Clarence Runoff Area=32,100 sf 48.47% Impervious Runoff Depth=1.12"
Flow Length=100' Slope=0.0200 '/' Tc=15.0 min CN=79 Runoff=1.04 cfs 0.069 af

Subcatchment EX2: EX-2 - South (Frost Ave) Runoff Area=6,738 sf 28.67% Impervious Runoff Depth=0.75"
Tc=5.0 min CN=72 Runoff=0.20 cfs 0.010 af

Subcatchment EX3: EX-3 - East (Ide St) Runoff Area=14,361 sf 28.92% Impervious Runoff Depth=0.75"
Flow Length=60' Slope=0.0090 '/' Tc=13.7 min CN=72 Runoff=0.30 cfs 0.021 af

Reach EXD: Existing Discharge Inflow=1.44 cfs 0.099 af
Outflow=1.44 cfs 0.099 af

Total Runoff Area = 1.221 ac Runoff Volume = 0.099 af Average Runoff Depth = 0.97"
59.32% Pervious = 0.724 ac 40.68% Impervious = 0.497 ac

Summary for Subcatchment EX1: EX-1 - West (Clarence St)

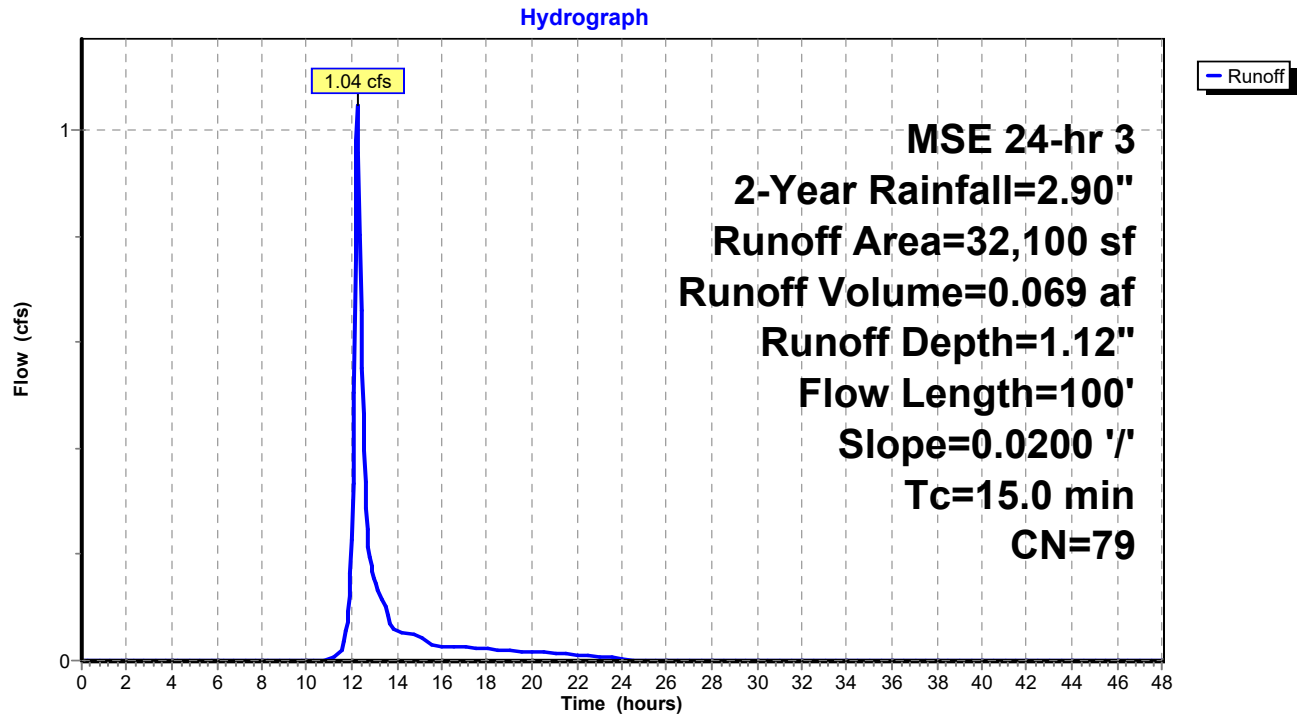
Runoff = 1.04 cfs @ 12.25 hrs, Volume= 0.069 af, Depth= 1.12"
Routed to Reach EXD : Existing Discharge

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2-Year Rainfall=2.90"

Area (sf)	CN	Description
15,558	98	Paved parking, HSG B
16,542	61	>75% Grass cover, Good, HSG B
32,100	79	Weighted Average
16,542		51.53% Pervious Area
15,558		48.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0	100	0.0200	0.11		**Sheet Flow, Northwest Corner** Grass: Dense n= 0.240 P2= 2.90"

Subcatchment EX1: EX-1 - West (Clarence St)



Summary for Subcatchment EX2: EX-2 - South (Frost Ave)

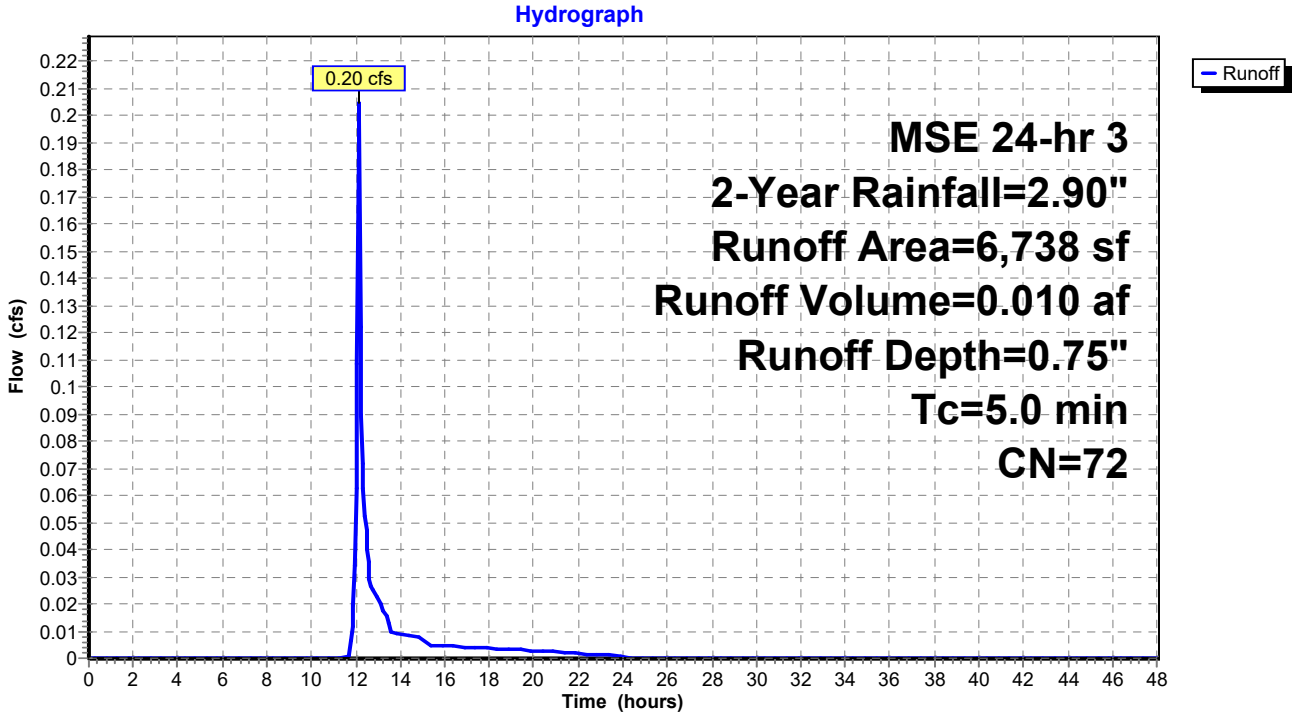
Runoff = 0.20 cfs @ 12.13 hrs, Volume= 0.010 af, Depth= 0.75"
Routed to Reach EXD : Existing Discharge

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2-Year Rainfall=2.90"

Area (sf)	CN	Description
1,932	98	Paved parking, HSG B
4,806	61	>75% Grass cover, Good, HSG B
6,738	72	Weighted Average
4,806		71.33% Pervious Area
1,932		28.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Minimum ToC**

Subcatchment EX2: EX-2 - South (Frost Ave)



Summary for Subcatchment EX3: EX-3 - East (Ide St)

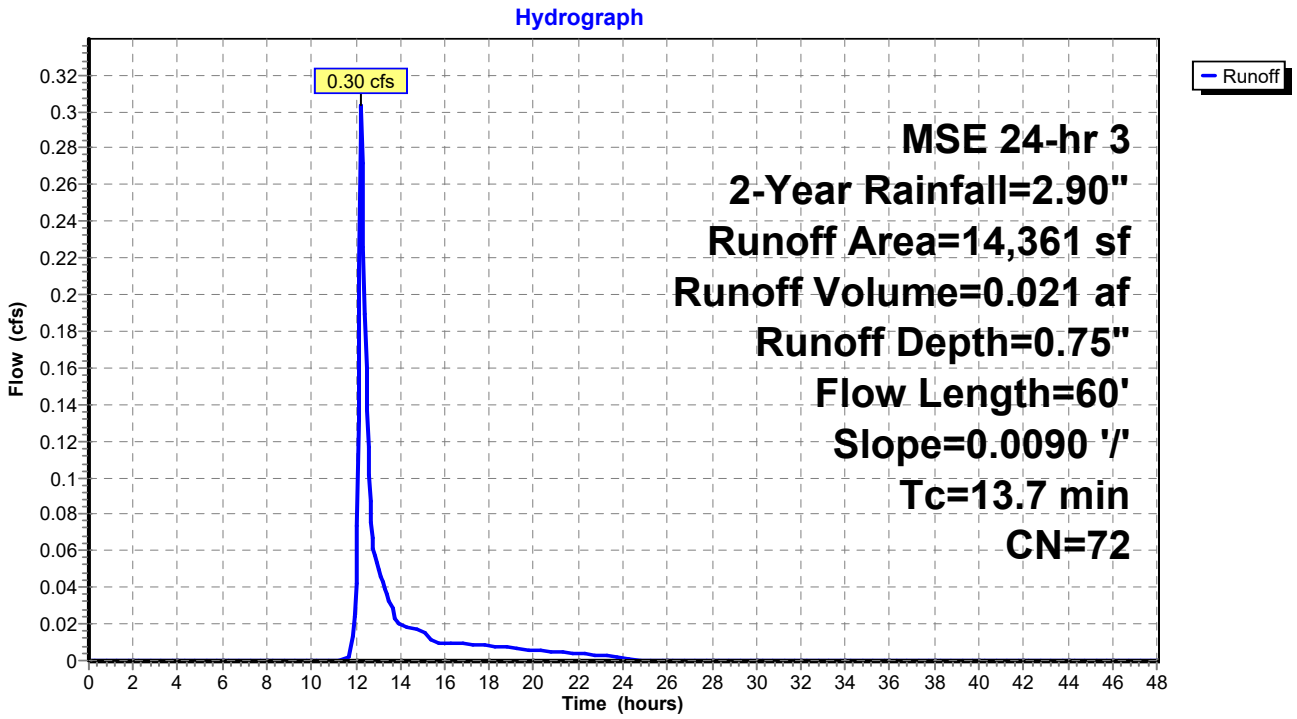
Runoff = 0.30 cfs @ 12.24 hrs, Volume= 0.021 af, Depth= 0.75"
Routed to Reach EXD : Existing Discharge

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2-Year Rainfall=2.90"

Area (sf)	CN	Description
4,153	98	Paved parking, HSG B
10,208	61	>75% Grass cover, Good, HSG B
14,361	72	Weighted Average
10,208		71.08% Pervious Area
4,153		28.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.7	60	0.0090	0.07		**Sheet Flow, East Sheet Flow** Grass: Dense n= 0.240 P2= 2.90"

Subcatchment EX3: EX-3 - East (Ide St)

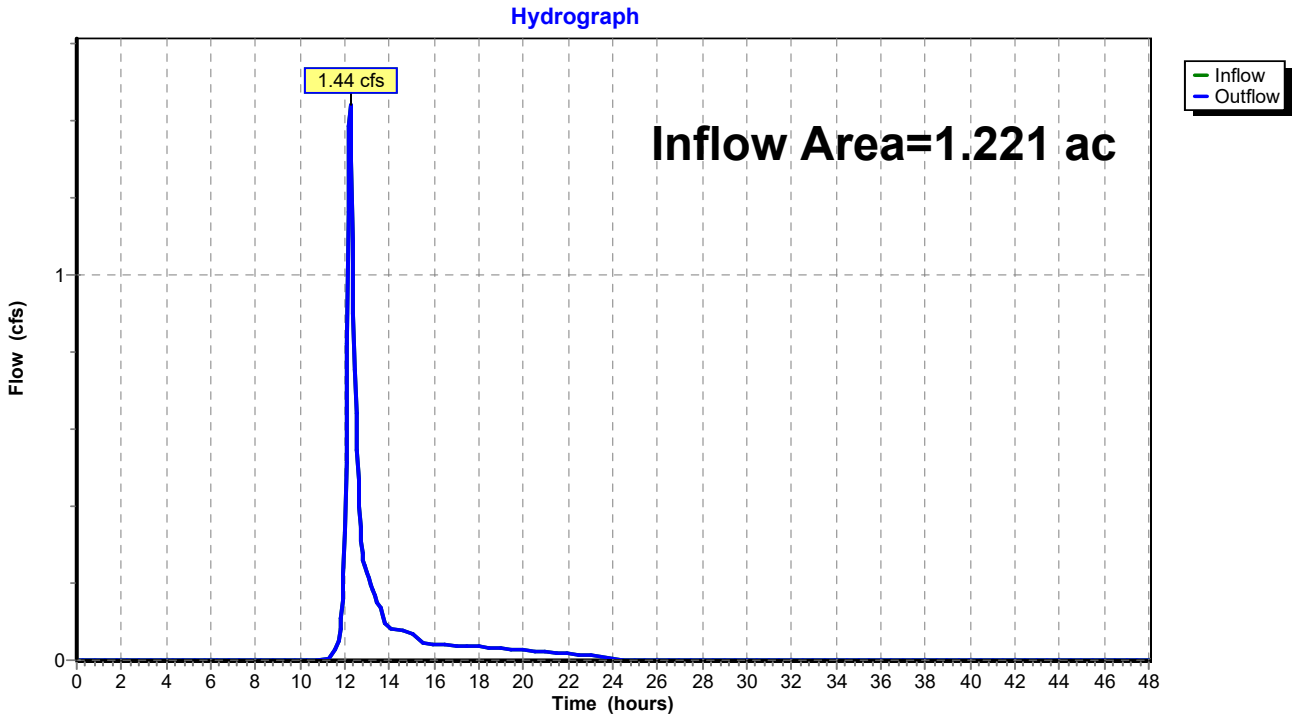


Summary for Reach EXD: Existing Discharge

Inflow Area = 1.221 ac, 40.68% Impervious, Inflow Depth = 0.97" for 2-Year event
Inflow = 1.44 cfs @ 12.24 hrs, Volume= 0.099 af
Outflow = 1.44 cfs @ 12.24 hrs, Volume= 0.099 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Reach EXD: Existing Discharge



Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment EX1: EX-1 - West (Clarence Runoff Area=32,100 sf 48.47% Impervious Runoff Depth=2.21"
Flow Length=100' Slope=0.0200 '/' Tc=15.0 min CN=79 Runoff=2.10 cfs 0.136 af

Subcatchment EX2: EX-2 - South (Frost Ave) Runoff Area=6,738 sf 28.67% Impervious Runoff Depth=1.67"
Tc=5.0 min CN=72 Runoff=0.48 cfs 0.022 af

Subcatchment EX3: EX-3 - East (Ide St) Runoff Area=14,361 sf 28.92% Impervious Runoff Depth=1.67"
Flow Length=60' Slope=0.0090 '/' Tc=13.7 min CN=72 Runoff=0.73 cfs 0.046 af

Reach EXD: Existing Discharge Inflow=3.04 cfs 0.203 af
Outflow=3.04 cfs 0.203 af

Total Runoff Area = 1.221 ac Runoff Volume = 0.203 af Average Runoff Depth = 2.00"
59.32% Pervious = 0.724 ac 40.68% Impervious = 0.497 ac

Summary for Subcatchment EX1: EX-1 - West (Clarence St)

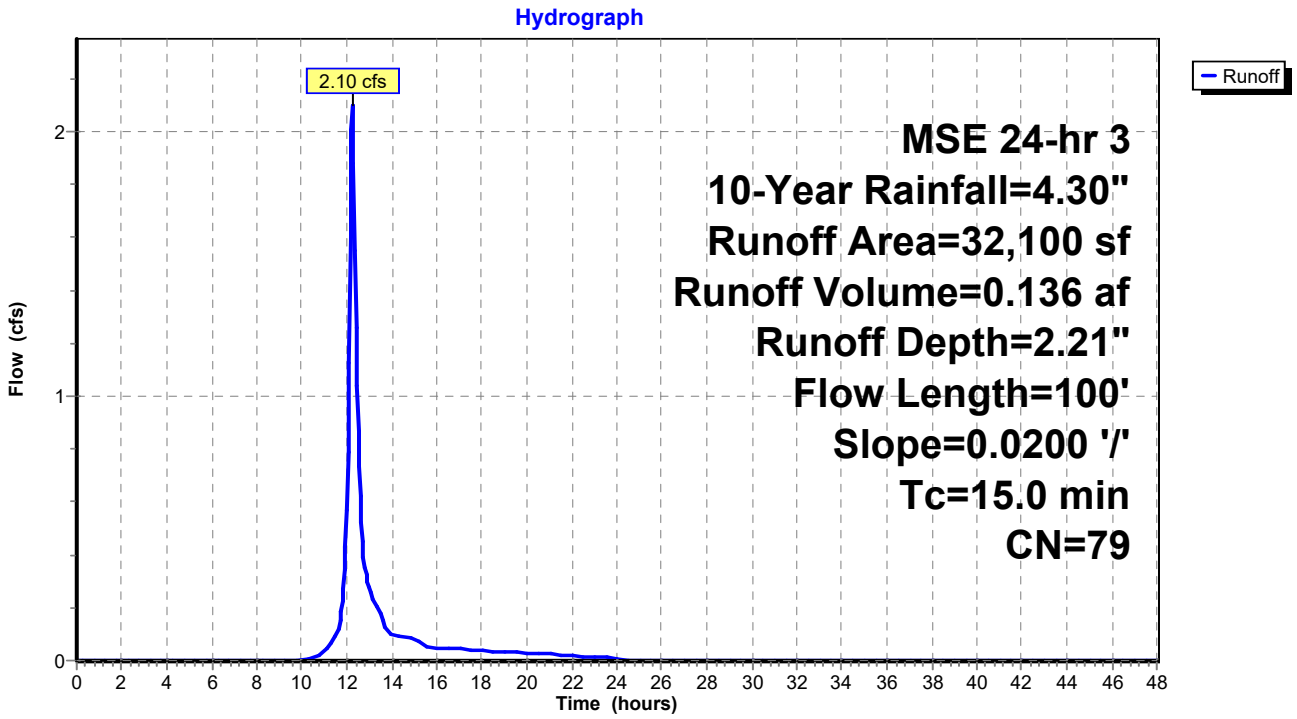
Runoff = 2.10 cfs @ 12.24 hrs, Volume= 0.136 af, Depth= 2.21"
Routed to Reach EXD : Existing Discharge

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.30"

Area (sf)	CN	Description
15,558	98	Paved parking, HSG B
16,542	61	>75% Grass cover, Good, HSG B
32,100	79	Weighted Average
16,542		51.53% Pervious Area
15,558		48.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0	100	0.0200	0.11		**Sheet Flow, Northwest Corner** Grass: Dense n= 0.240 P2= 2.90"

Subcatchment EX1: EX-1 - West (Clarence St)



Summary for Subcatchment EX2: EX-2 - South (Frost Ave)

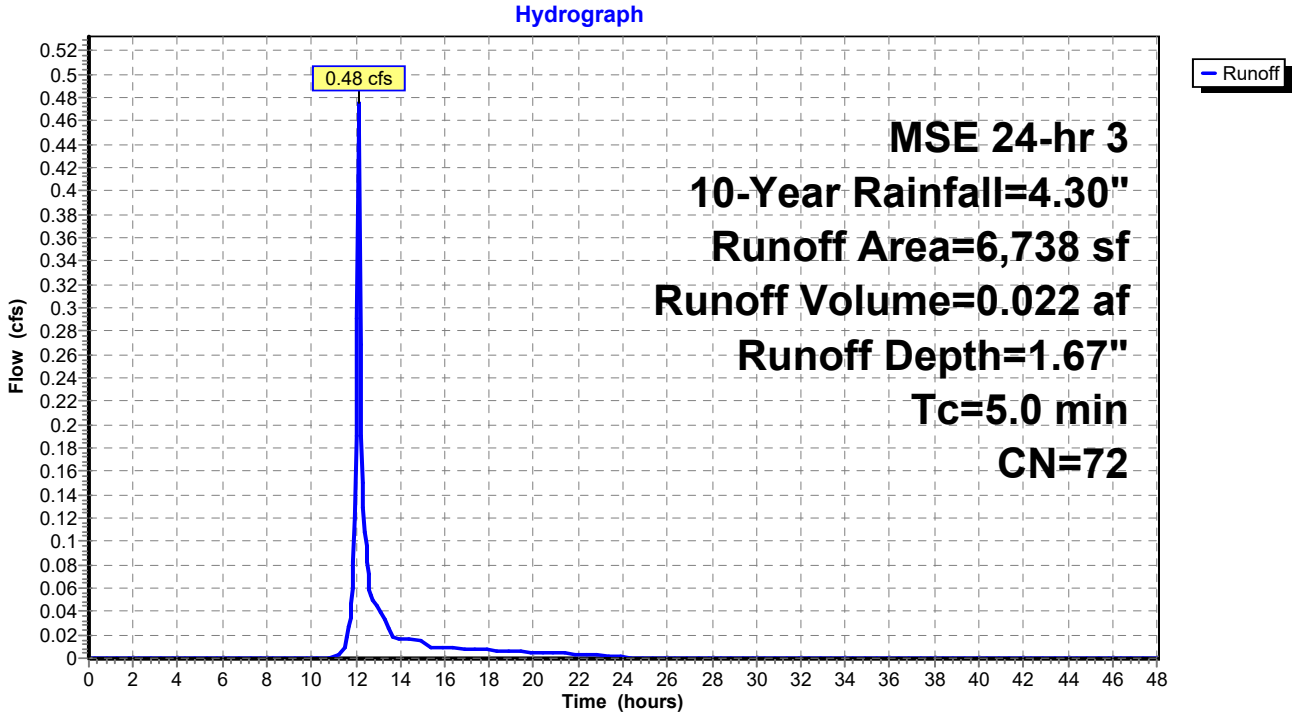
Runoff = 0.48 cfs @ 12.12 hrs, Volume= 0.022 af, Depth= 1.67"
Routed to Reach EXD : Existing Discharge

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.30"

Area (sf)	CN	Description
1,932	98	Paved parking, HSG B
4,806	61	>75% Grass cover, Good, HSG B
6,738	72	Weighted Average
4,806		71.33% Pervious Area
1,932		28.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Minimum ToC**

Subcatchment EX2: EX-2 - South (Frost Ave)



Summary for Subcatchment EX3: EX-3 - East (Ide St)

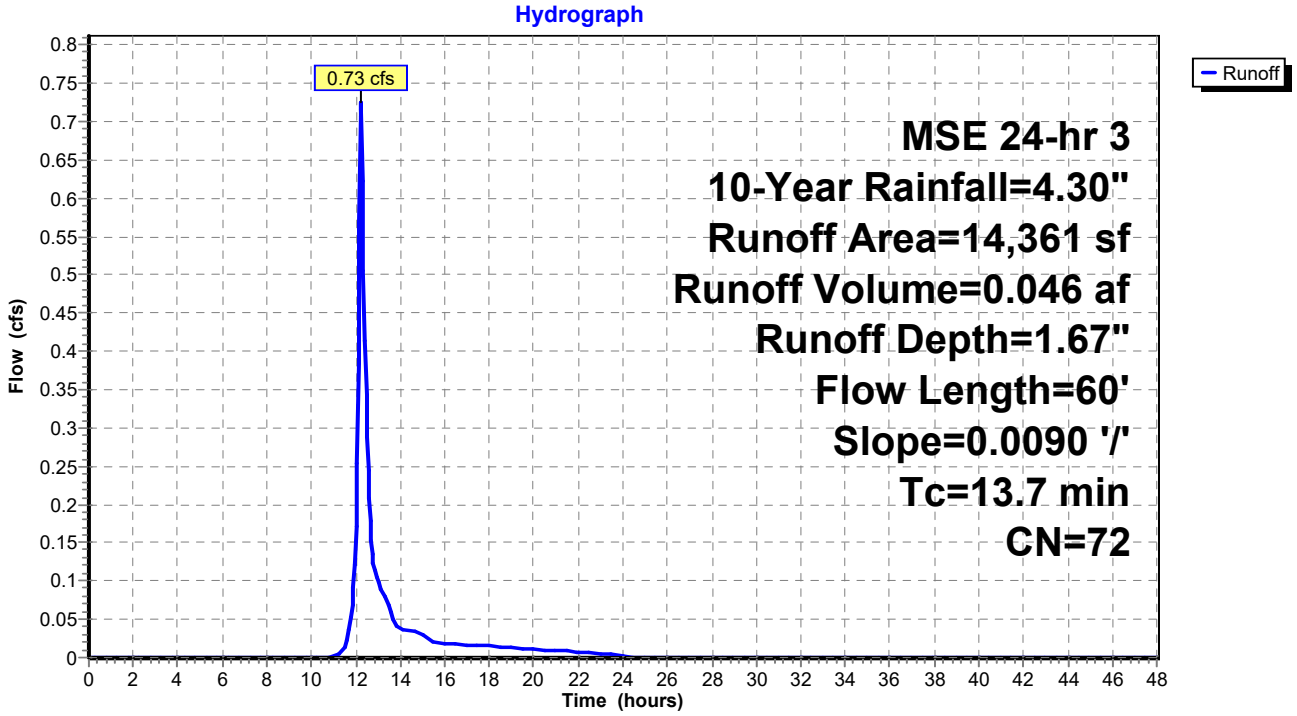
Runoff = 0.73 cfs @ 12.23 hrs, Volume= 0.046 af, Depth= 1.67"
Routed to Reach EXD : Existing Discharge

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.30"

Area (sf)	CN	Description
4,153	98	Paved parking, HSG B
10,208	61	>75% Grass cover, Good, HSG B
14,361	72	Weighted Average
10,208		71.08% Pervious Area
4,153		28.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.7	60	0.0090	0.07		**Sheet Flow, East Sheet Flow** Grass: Dense n= 0.240 P2= 2.90"

Subcatchment EX3: EX-3 - East (Ide St)

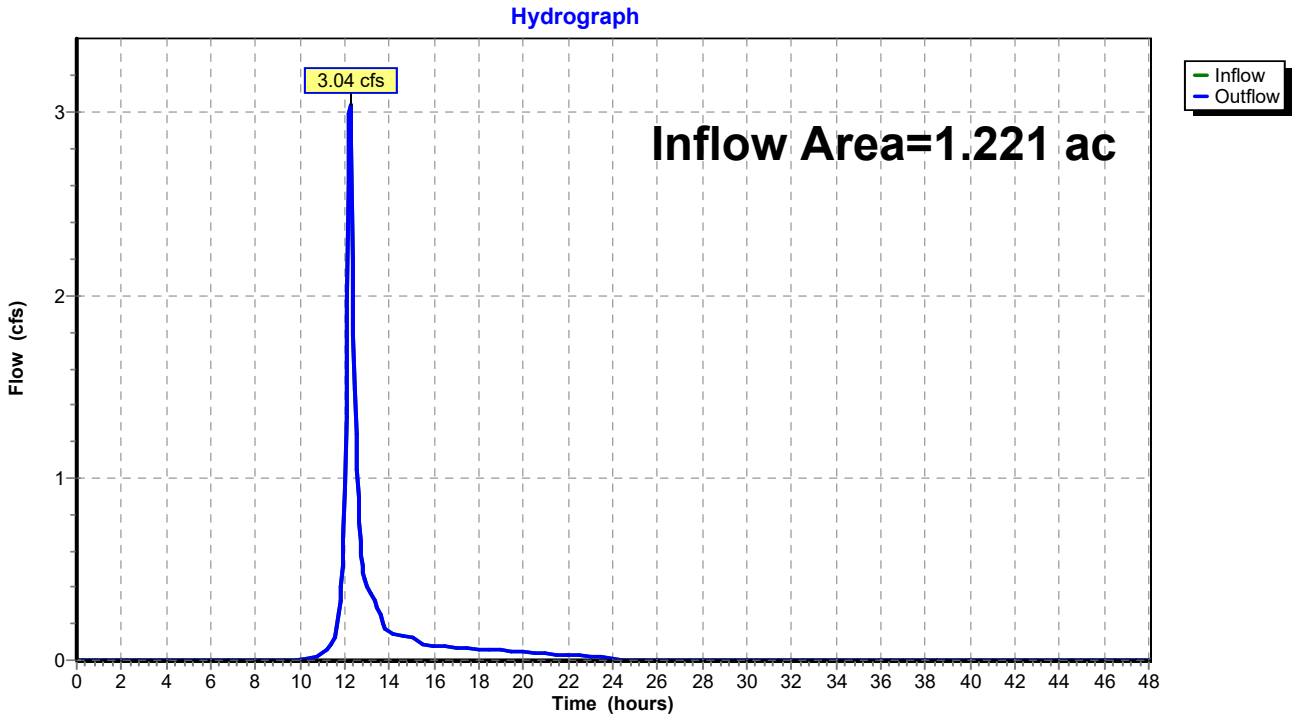


Summary for Reach EXD: Existing Discharge

Inflow Area = 1.221 ac, 40.68% Impervious, Inflow Depth = 2.00" for 10-Year event
Inflow = 3.04 cfs @ 12.23 hrs, Volume= 0.203 af
Outflow = 3.04 cfs @ 12.23 hrs, Volume= 0.203 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Reach EXD: Existing Discharge



Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment EX1: EX-1 - West (Clarence Runoff Area=32,100 sf 48.47% Impervious Runoff Depth=5.04"
Flow Length=100' Slope=0.0200 '/' Tc=15.0 min CN=79 Runoff=4.73 cfs 0.310 af

Subcatchment EX2: EX-2 - South (Frost Ave) Runoff Area=6,738 sf 28.67% Impervious Runoff Depth=4.26"
Tc=5.0 min CN=72 Runoff=1.21 cfs 0.055 af

Subcatchment EX3: EX-3 - East (Ide St) Runoff Area=14,361 sf 28.92% Impervious Runoff Depth=4.26"
Flow Length=60' Slope=0.0090 '/' Tc=13.7 min CN=72 Runoff=1.88 cfs 0.117 af

Reach EXD: Existing Discharge Inflow=7.14 cfs 0.482 af
Outflow=7.14 cfs 0.482 af

Total Runoff Area = 1.221 ac Runoff Volume = 0.482 af Average Runoff Depth = 4.73"
59.32% Pervious = 0.724 ac 40.68% Impervious = 0.497 ac

Summary for Subcatchment EX1: EX-1 - West (Clarence St)

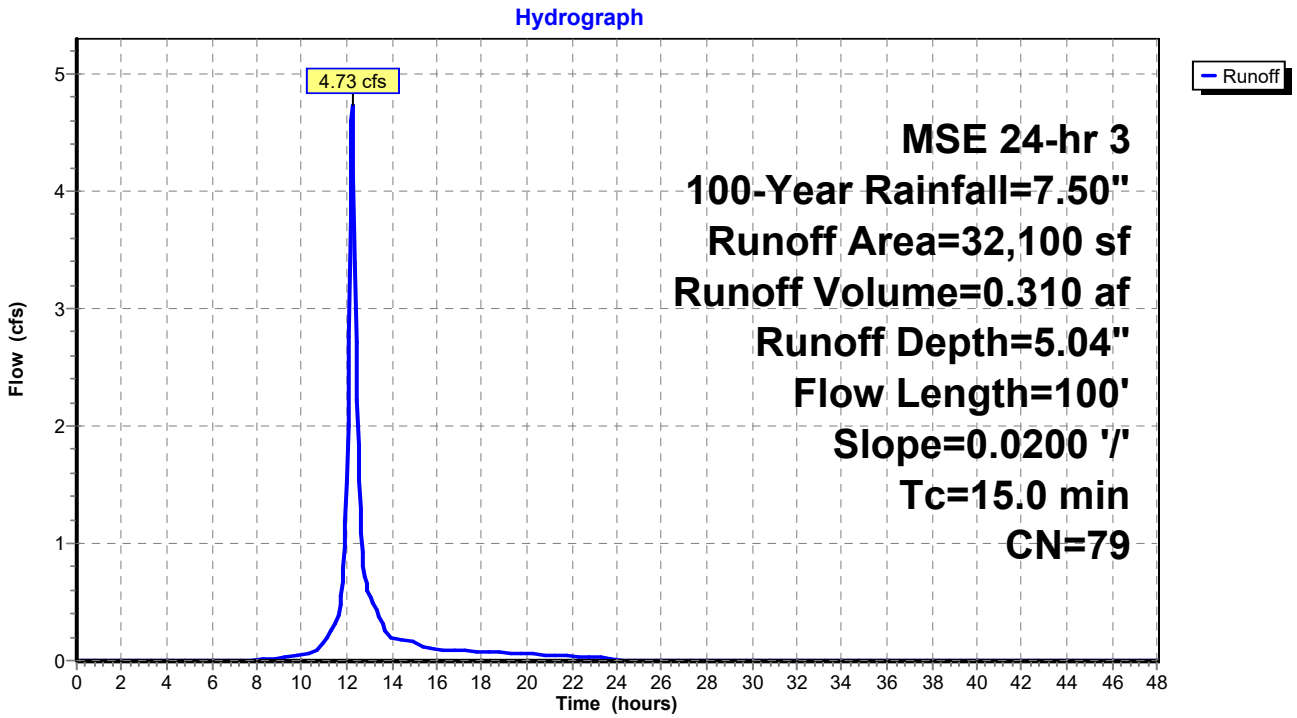
Runoff = 4.73 cfs @ 12.23 hrs, Volume= 0.310 af, Depth= 5.04"
Routed to Reach EXD : Existing Discharge

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

Area (sf)	CN	Description
15,558	98	Paved parking, HSG B
16,542	61	>75% Grass cover, Good, HSG B
32,100	79	Weighted Average
16,542		51.53% Pervious Area
15,558		48.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0	100	0.0200	0.11		**Sheet Flow, Northwest Corner** Grass: Dense n= 0.240 P2= 2.90"

Subcatchment EX1: EX-1 - West (Clarence St)



Summary for Subcatchment EX2: EX-2 - South (Frost Ave)

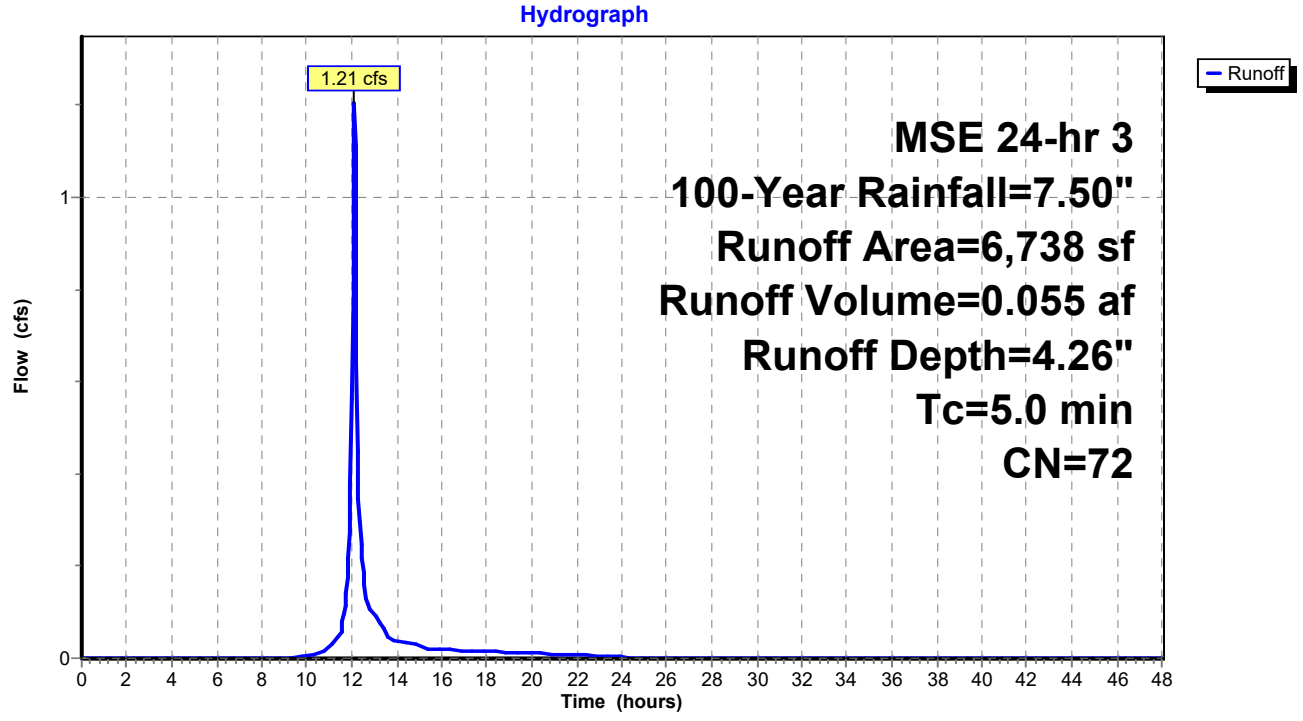
Runoff = 1.21 cfs @ 12.12 hrs, Volume= 0.055 af, Depth= 4.26"
Routed to Reach EXD : Existing Discharge

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

Area (sf)	CN	Description
1,932	98	Paved parking, HSG B
4,806	61	>75% Grass cover, Good, HSG B
6,738	72	Weighted Average
4,806		71.33% Pervious Area
1,932		28.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Minimum ToC**

Subcatchment EX2: EX-2 - South (Frost Ave)



Summary for Subcatchment EX3: EX-3 - East (Ide St)

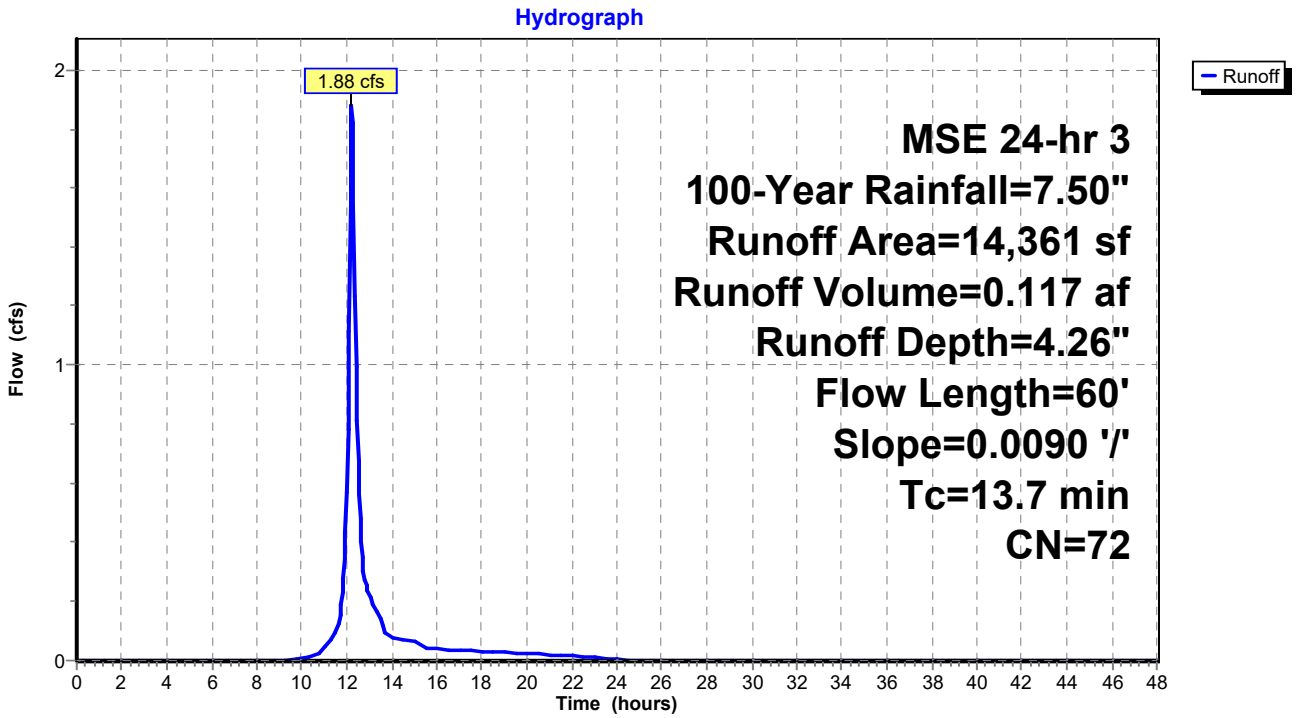
Runoff = 1.88 cfs @ 12.22 hrs, Volume= 0.117 af, Depth= 4.26"
Routed to Reach EXD : Existing Discharge

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

Area (sf)	CN	Description
4,153	98	Paved parking, HSG B
10,208	61	>75% Grass cover, Good, HSG B
14,361	72	Weighted Average
10,208		71.08% Pervious Area
4,153		28.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.7	60	0.0090	0.07		**Sheet Flow, East Sheet Flow** Grass: Dense n= 0.240 P2= 2.90"

Subcatchment EX3: EX-3 - East (Ide St)

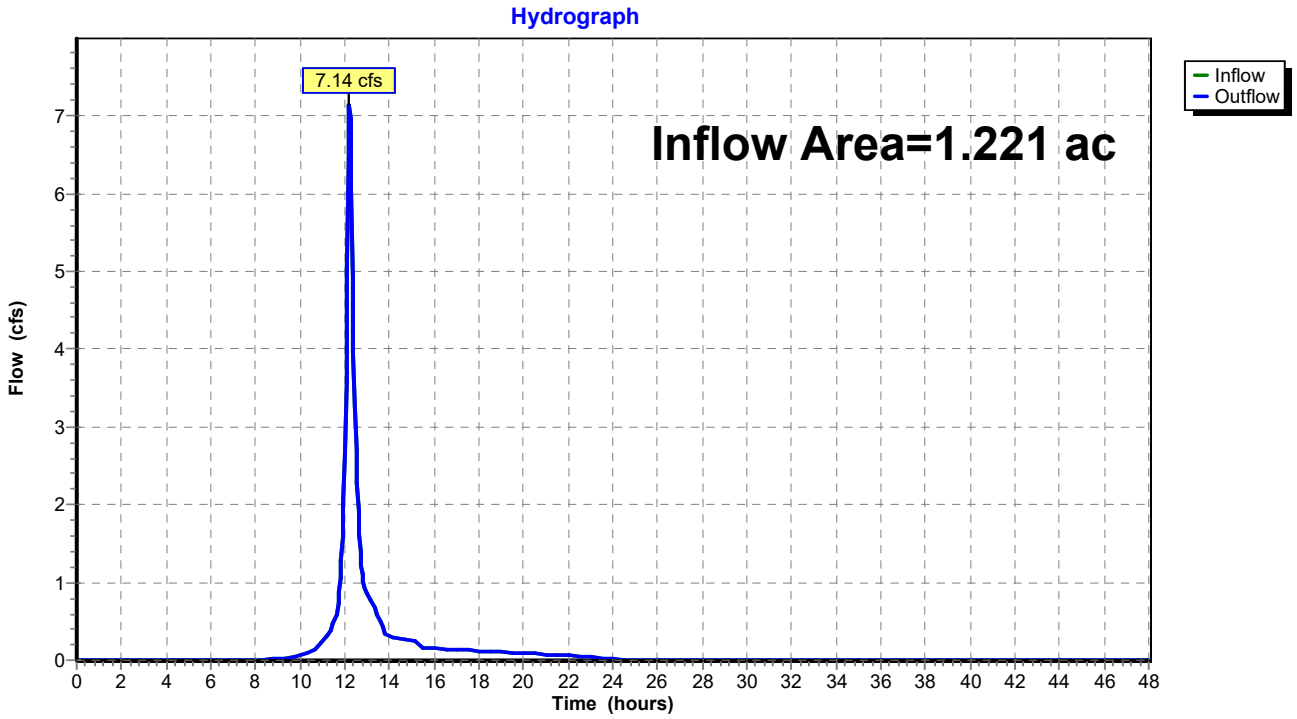


Summary for Reach EXD: Existing Discharge

Inflow Area = 1.221 ac, 40.68% Impervious, Inflow Depth = 4.73" for 100-Year event
Inflow = 7.14 cfs @ 12.22 hrs, Volume= 0.482 af
Outflow = 7.14 cfs @ 12.22 hrs, Volume= 0.482 af, Atten= 0%, Lag= 0.0 min

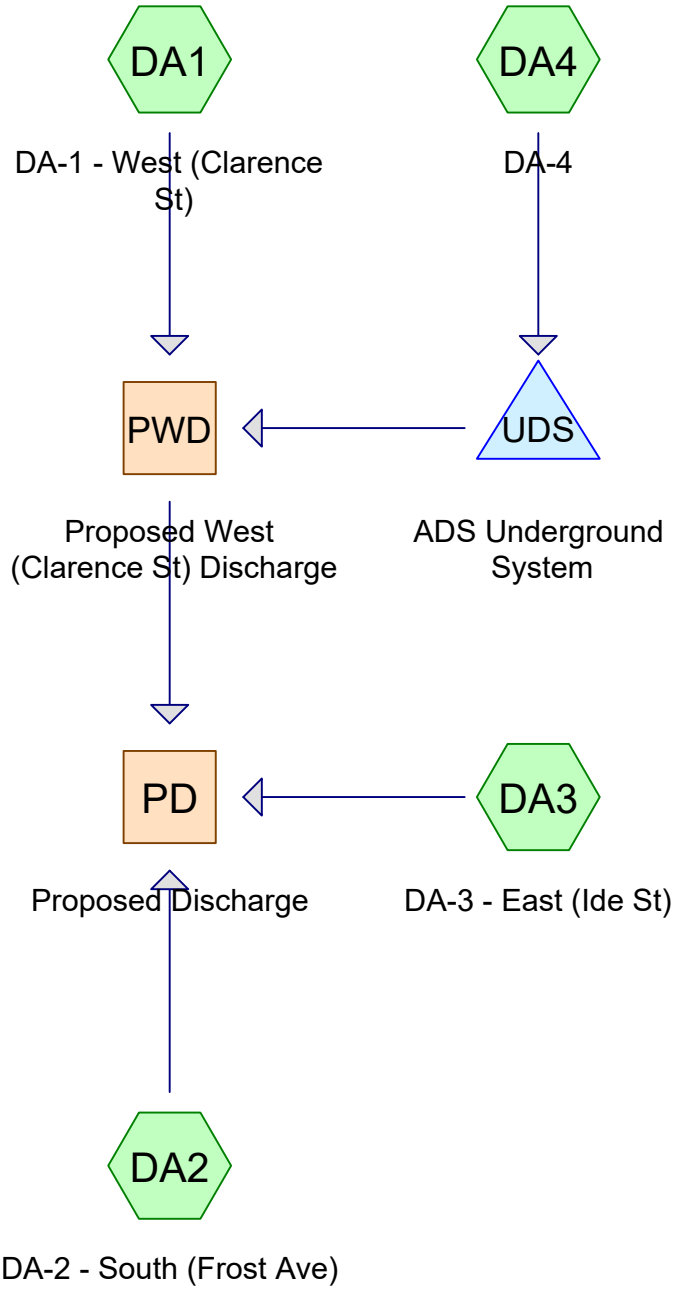
Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Reach EXD: Existing Discharge



Appendix D: Proposed Conditions HydroCAD

PROPOSED



Subcat Reach Pond Link

Routing Diagram for 29050 HydroCAD
Prepared by I&S Group, Inc, Printed 5/23/2023

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	MSE 24-hr	3	Default	24.00	1	2.90	2
2	10-Year	MSE 24-hr	3	Default	24.00	1	4.30	2
3	100-Year	MSE 24-hr	3	Default	24.00	1	7.50	2

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.453	61	>75% Grass cover, Good, HSG B (DA1, DA2, DA3, DA4)
0.769	98	Paved parking, HSG B (DA1, DA2, DA3, DA4)
1.221	**84**	**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment DA1: DA-1 - West (Clarence Runoff Area=16,636 sf 21.80% Impervious Runoff Depth=0.62"
Flow Length=61' Slope=0.0360 '/' Tc=8.0 min CN=69 Runoff=0.35 cfs 0.020 af

Subcatchment DA2: DA-2 - South (Frost Ave) Runoff Area=3,783 sf 3.73% Impervious Runoff Depth=0.36"
Tc=5.0 min CN=62 Runoff=0.04 cfs 0.003 af

Subcatchment DA3: DA-3 - East (Ide St) Runoff Area=3,788 sf 29.59% Impervious Runoff Depth=0.75"
Tc=5.0 min CN=72 Runoff=0.12 cfs 0.005 af

Subcatchment DA4: DA-4 Runoff Area=28,991 sf 98.61% Impervious Runoff Depth=2.56"
Tc=5.0 min CN=97 Runoff=2.79 cfs 0.142 af

Reach PD: Proposed Discharge Inflow=0.50 cfs 0.049 af
Outflow=0.50 cfs 0.049 af

Reach PWD: Proposed West (Clarence St) Discharge Inflow=0.35 cfs 0.041 af
Outflow=0.35 cfs 0.041 af

Pond UDS: ADS Underground System Peak Elev=897.84' Storage=3,768 cf Inflow=2.79 cfs 0.142 af
Discarded=0.04 cfs 0.120 af Primary=0.12 cfs 0.022 af Outflow=0.16 cfs 0.142 af

Total Runoff Area = 1.221 ac Runoff Volume = 0.170 af Average Runoff Depth = 1.67"
37.07% Pervious = 0.453 ac 62.93% Impervious = 0.769 ac

Summary for Subcatchment DA1: DA-1 - West (Clarence St)

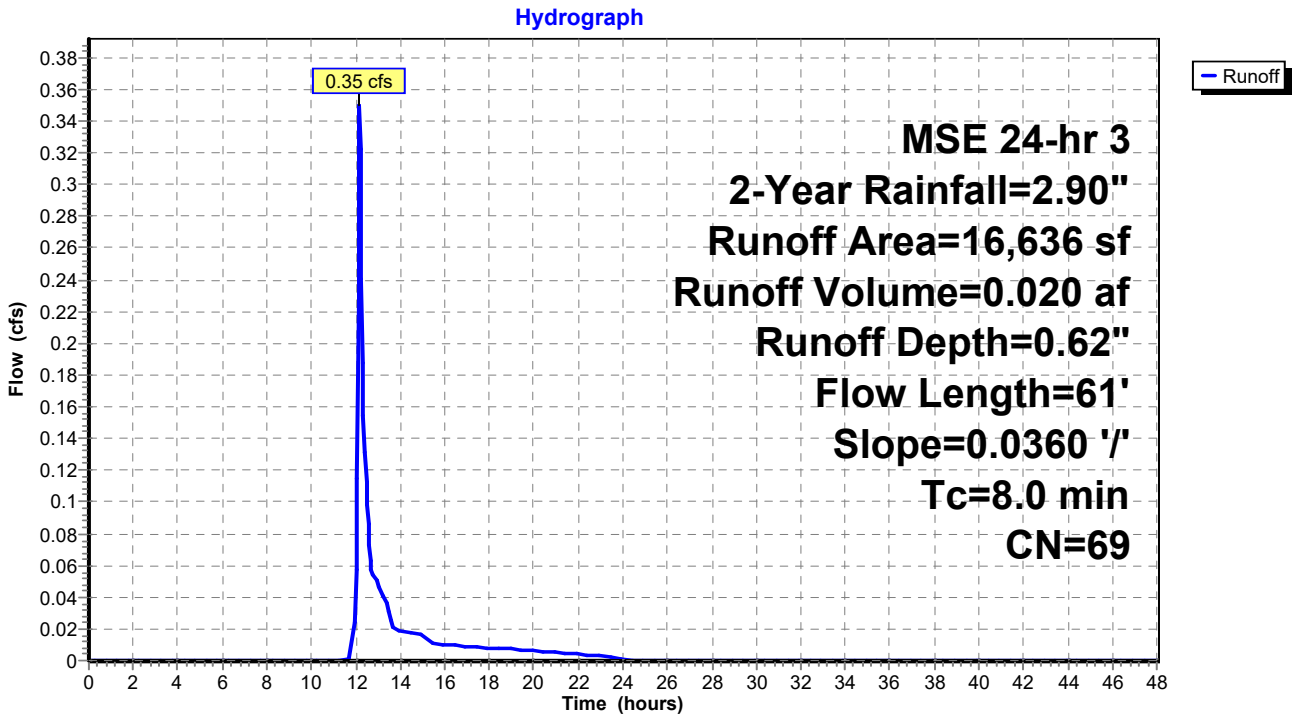
Runoff = 0.35 cfs @ 12.17 hrs, Volume= 0.020 af, Depth= 0.62"
Routed to Reach PWD : Proposed West (Clarence St) Discharge

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2-Year Rainfall=2.90"

Area (sf)	CN	Description
3,626	98	Paved parking, HSG B
13,010	61	>75% Grass cover, Good, HSG B
16,636	69	Weighted Average
13,010		78.20% Pervious Area
3,626		21.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	61	0.0360	0.13		**Sheet Flow, North Sheet Flow** Grass: Dense n= 0.240 P2= 2.90"

Subcatchment DA1: DA-1 - West (Clarence St)



Summary for Subcatchment DA2: DA-2 - South (Frost Ave)

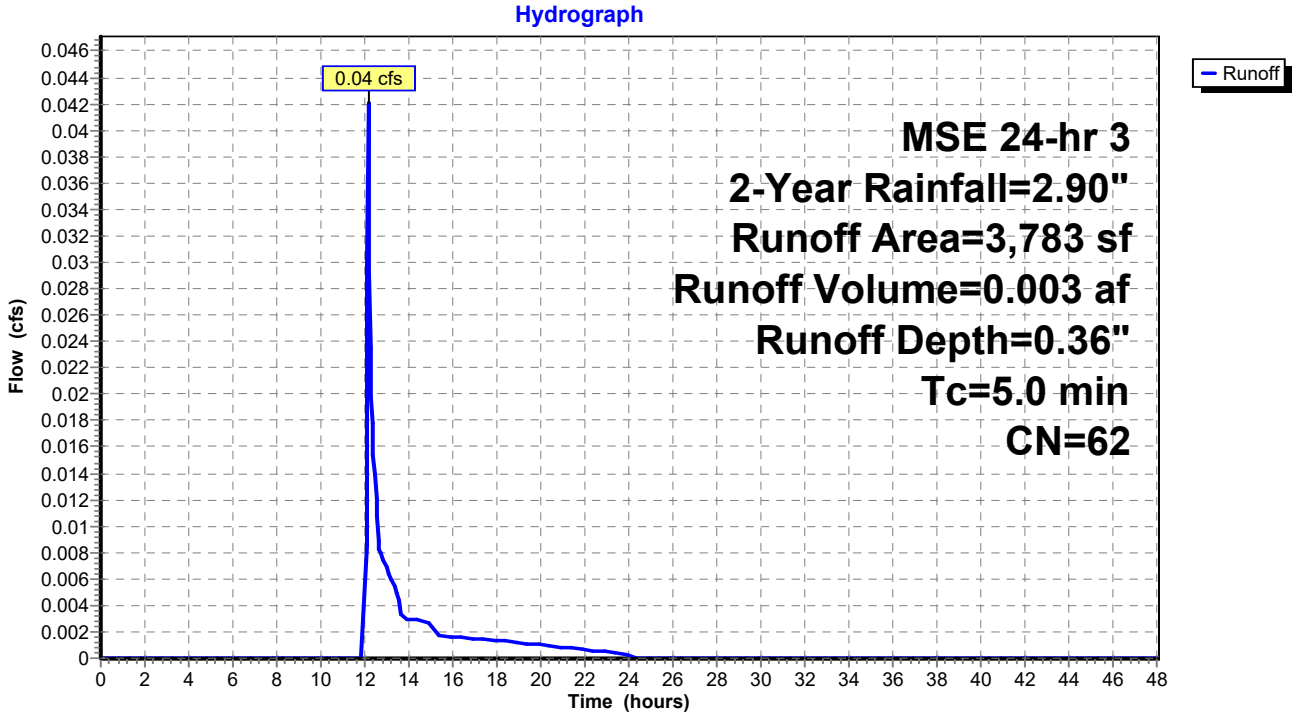
Runoff = 0.04 cfs @ 12.15 hrs, Volume= 0.003 af, Depth= 0.36"
Routed to Reach PD : Proposed Discharge

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2-Year Rainfall=2.90"

Area (sf)	CN	Description
141	98	Paved parking, HSG B
3,642	61	>75% Grass cover, Good, HSG B
3,783	62	Weighted Average
3,642		96.27% Pervious Area
141		3.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Minimum ToC**

Subcatchment DA2: DA-2 - South (Frost Ave)



Summary for Subcatchment DA3: DA-3 - East (Ide St)

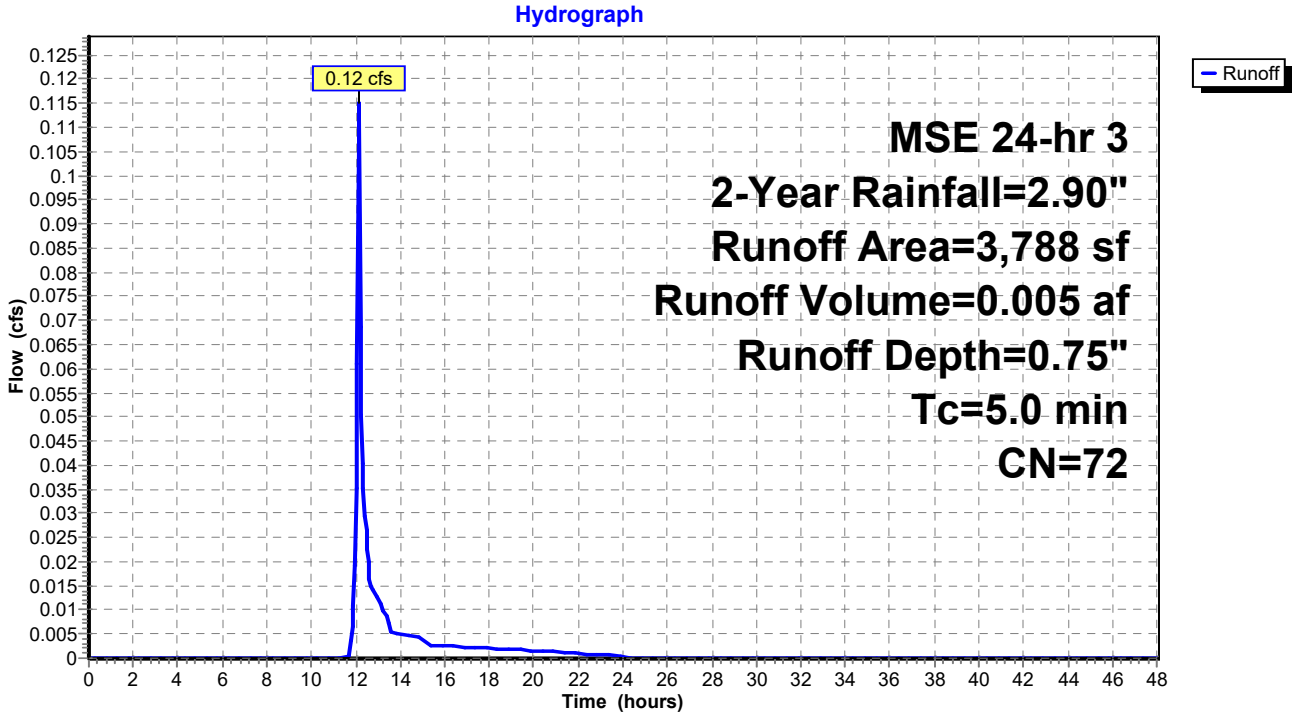
Runoff = 0.12 cfs @ 12.13 hrs, Volume= 0.005 af, Depth= 0.75"
Routed to Reach PD : Proposed Discharge

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2-Year Rainfall=2.90"

Area (sf)	CN	Description
1,121	98	Paved parking, HSG B
2,667	61	>75% Grass cover, Good, HSG B
3,788	72	Weighted Average
2,667		70.41% Pervious Area
1,121		29.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Minimum ToC**

Subcatchment DA3: DA-3 - East (Ide St)



Summary for Subcatchment DA4: DA-4

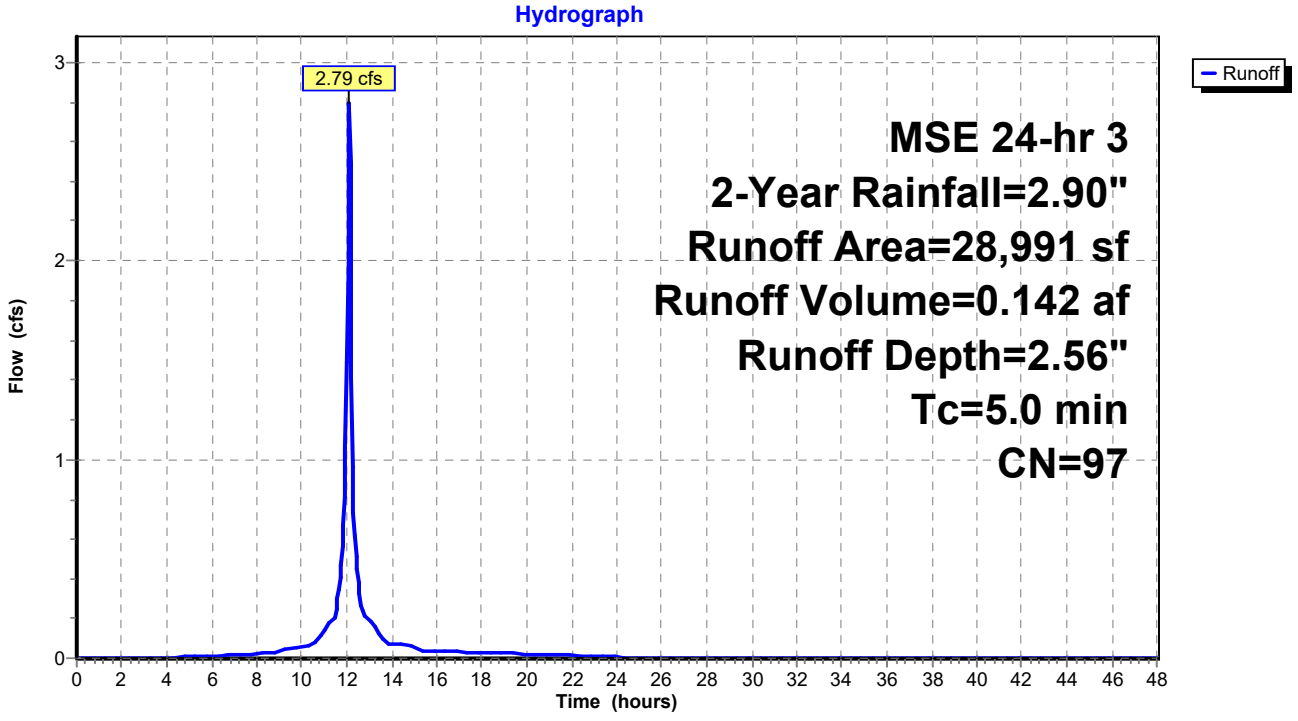
Runoff = 2.79 cfs @ 12.11 hrs, Volume= 0.142 af, Depth= 2.56"
Routed to Pond UDS : ADS Underground System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2-Year Rainfall=2.90"

Area (sf)	CN	Description
28,588	98	Paved parking, HSG B
403	61	>75% Grass cover, Good, HSG B
28,991	97	Weighted Average
403		1.39% Pervious Area
28,588		98.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Minimum ToC**

Subcatchment DA4: DA-4

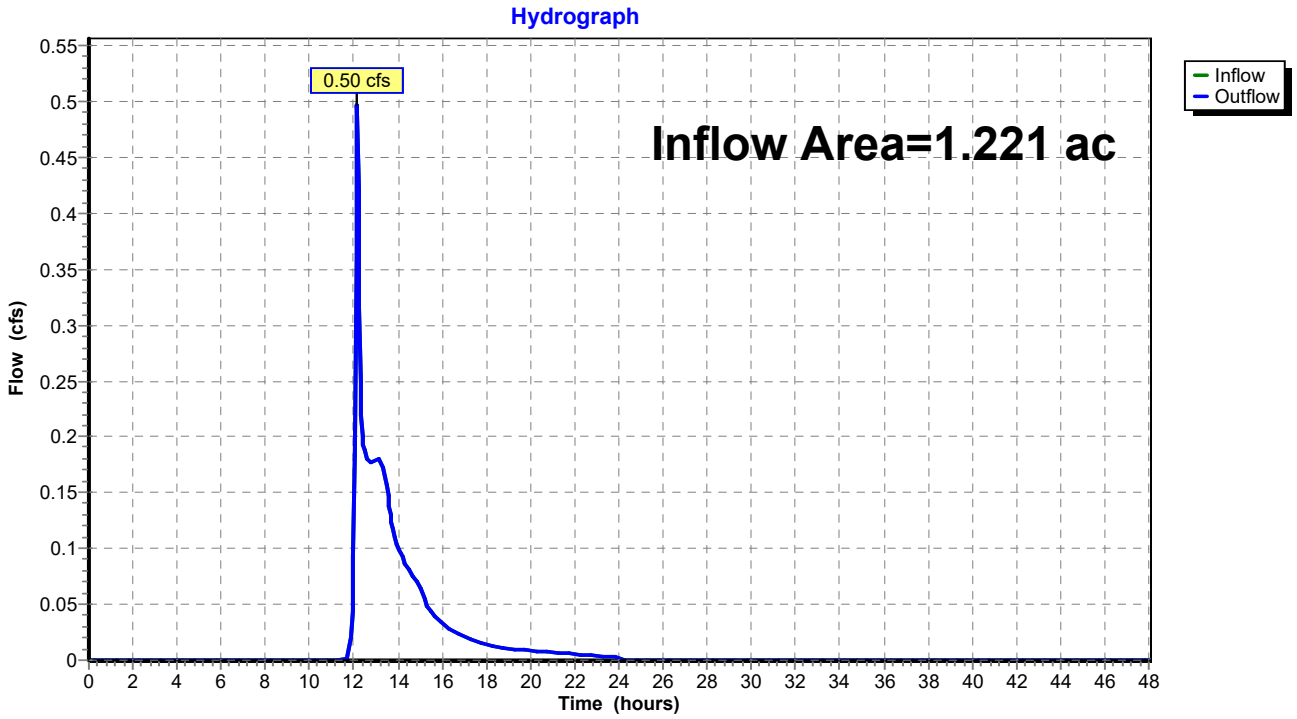


Summary for Reach PD: Proposed Discharge

Inflow Area = 1.221 ac, 62.93% Impervious, Inflow Depth = 0.49" for 2-Year event
Inflow = 0.50 cfs @ 12.16 hrs, Volume= 0.049 af
Outflow = 0.50 cfs @ 12.16 hrs, Volume= 0.049 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Reach PD: Proposed Discharge

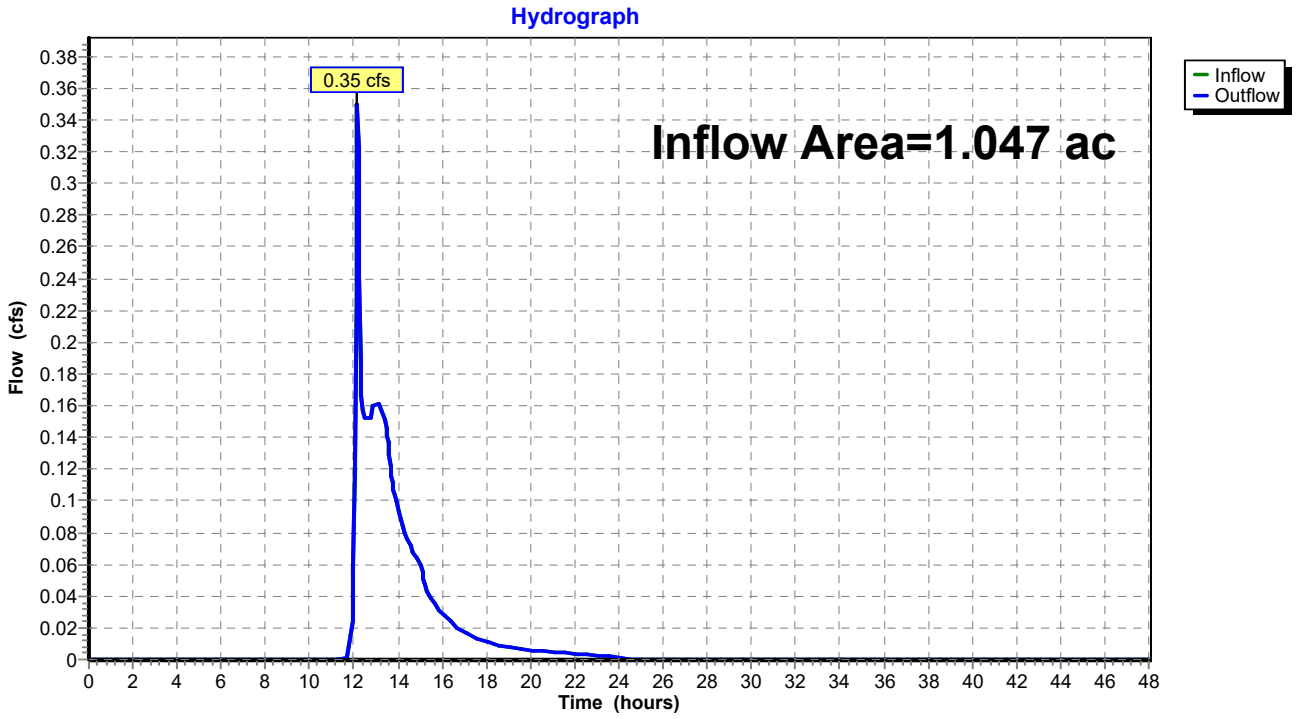


Summary for Reach PWD: Proposed West (Clarence St) Discharge

Inflow Area = 1.047 ac, 70.60% Impervious, Inflow Depth = 0.47" for 2-Year event
Inflow = 0.35 cfs @ 12.17 hrs, Volume= 0.041 af
Outflow = 0.35 cfs @ 12.17 hrs, Volume= 0.041 af, Atten= 0%, Lag= 0.0 min
Routed to Reach PD : Proposed Discharge

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Reach PWD: Proposed West (Clarence St) Discharge



Summary for Pond UDS: ADS Underground System

Inflow Area = 0.666 ac, 98.61% Impervious, Inflow Depth = 2.56" for 2-Year event
Inflow = 2.79 cfs @ 12.11 hrs, Volume= 0.142 af
Outflow = 0.16 cfs @ 13.17 hrs, Volume= 0.142 af, Atten= 94%, Lag= 63.7 min
Discarded = 0.04 cfs @ 10.80 hrs, Volume= 0.120 af
Primary = 0.12 cfs @ 13.17 hrs, Volume= 0.022 af
Routed to Reach PWD : Proposed West (Clarence St) Discharge

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 897.84' @ 13.17 hrs Surf.Area= 4,080 sf Storage= 3,768 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 614.2 min (1,374.5 - 760.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	896.45'	3,654 cf	**39.50'W x 103.30'L x 3.50'H Field A** 14,281 cf Overall - 5,145 cf Embedded = 9,135 cf x 40.0% Voids
#2A	896.95'	5,145 cf	**ADS_StormTech SC-740 +Cap** x 112 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 112 Chambers in 8 Rows
		8,799 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	897.65'	**12.0" Round Culvert** L= 20.6' Ke= 0.500 Inlet / Outlet Invert= 897.65' / 897.50' S= 0.0073 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	897.65'	**8.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	895.65'	**Custom Weir, Cv= 2.62 (C= 3.28)** Elev. (feet) 895.65 899.75 899.75 900.68 900.68 902.27 Width (feet) 0.00 0.00 4.00 4.00 2.00 2.00
#4	Discarded	896.45'	**0.450 in/hr Infiltration over Surface area**

Discarded OutFlow Max=0.04 cfs @ 10.80 hrs HW=896.51' (Free Discharge)
└**4=Infiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.12 cfs @ 13.17 hrs HW=897.84' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Barrel Controls 0.12 cfs @ 1.76 fps)
  ├**2=Orifice** (Passes 0.12 cfs of 0.12 cfs potential flow)
  └**3=Custom Weir** (Controls 0.00 cfs)

Pond UDS: ADS Underground System - Chamber Wizard Field A

Chamber Model = ADS_StormTechSC-740 +Cap (ADS StormTech®SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

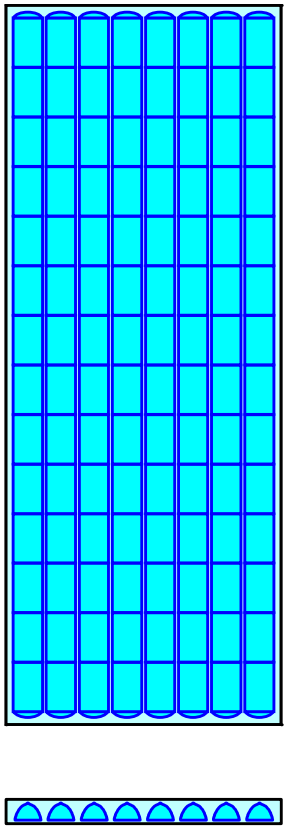
14 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 101.30' Row Length +12.0" End Stone x 2 = 103.30' Base Length
8 Rows x 51.0" Wide + 6.0" Spacing x 7 + 12.0" Side Stone x 2 = 39.50' Base Width
6.0" Stone Base + 30.0" Chamber Height + 6.0" Stone Cover = 3.50' Field Height

112 Chambers x 45.9 cf = 5,145.3 cf Chamber Storage

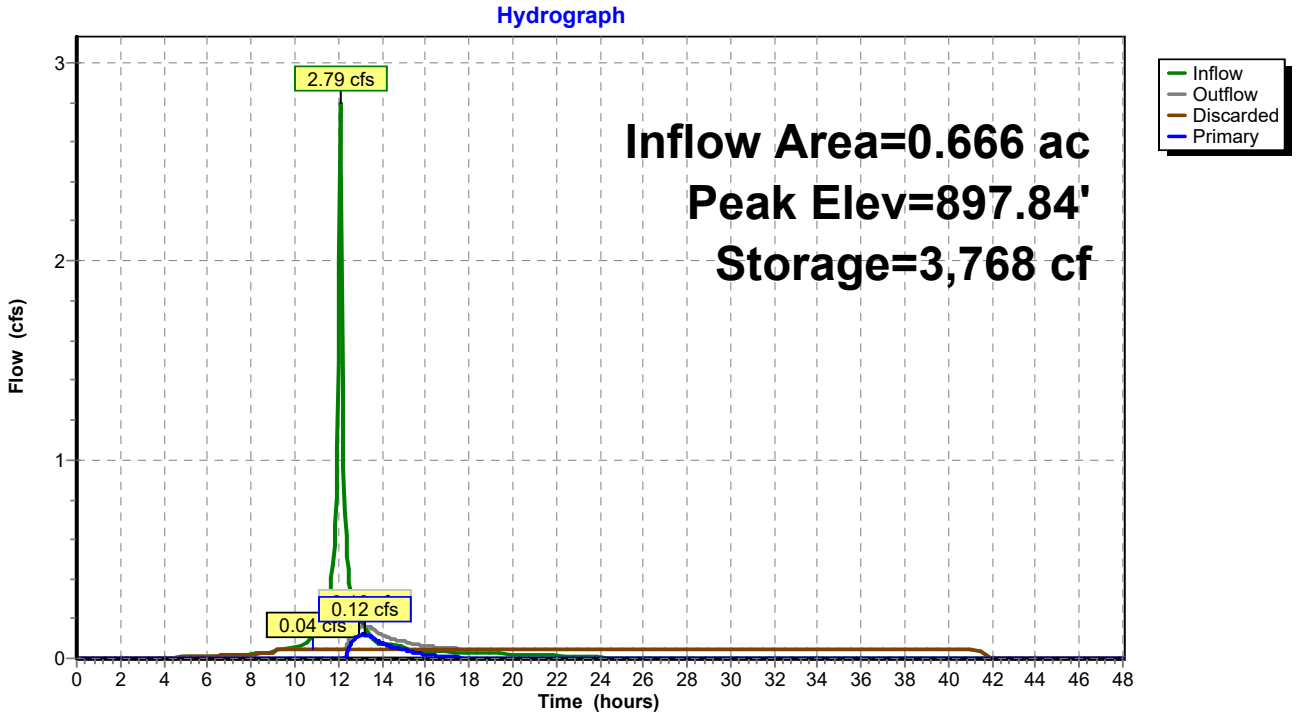
14,280.8 cf Field - 5,145.3 cf Chambers = 9,135.5 cf Stone x 40.0% Voids = 3,654.2 cf Stone Storage

Chamber Storage + Stone Storage = 8,799.5 cf = 0.202 af
Overall Storage Efficiency = 61.6%
Overall System Size = 103.30' x 39.50' x 3.50'

112 Chambers
528.9 cy Field
338.4 cy Stone



Pond UDS: ADS Underground System



Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment DA1: DA-1 - West (Clarence Runoff Area=16,636 sf 21.80% Impervious Runoff Depth=1.47"
Flow Length=61' Slope=0.0360 '/' Tc=8.0 min CN=69 Runoff=0.92 cfs 0.047 af

Subcatchment DA2: DA-2 - South (Frost Ave) Runoff Area=3,783 sf 3.73% Impervious Runoff Depth=1.03"
Tc=5.0 min CN=62 Runoff=0.16 cfs 0.007 af

Subcatchment DA3: DA-3 - East (Ide St) Runoff Area=3,788 sf 29.59% Impervious Runoff Depth=1.67"
Tc=5.0 min CN=72 Runoff=0.27 cfs 0.012 af

Subcatchment DA4: DA-4 Runoff Area=28,991 sf 98.61% Impervious Runoff Depth=3.95"
Tc=5.0 min CN=97 Runoff=4.21 cfs 0.219 af

Reach PD: Proposed Discharge Inflow=1.66 cfs 0.154 af
Outflow=1.66 cfs 0.154 af

Reach PWD: Proposed West (Clarence St) Discharge Inflow=1.40 cfs 0.134 af
Outflow=1.40 cfs 0.134 af

Pond UDS: ADS Underground System Peak Elev=898.21' Storage=4,927 cf Inflow=4.21 cfs 0.219 af
Discarded=0.04 cfs 0.131 af Primary=0.80 cfs 0.088 af Outflow=0.84 cfs 0.219 af

Total Runoff Area = 1.221 ac Runoff Volume = 0.285 af Average Runoff Depth = 2.80"
37.07% Pervious = 0.453 ac 62.93% Impervious = 0.769 ac

Summary for Subcatchment DA1: DA-1 - West (Clarence St)

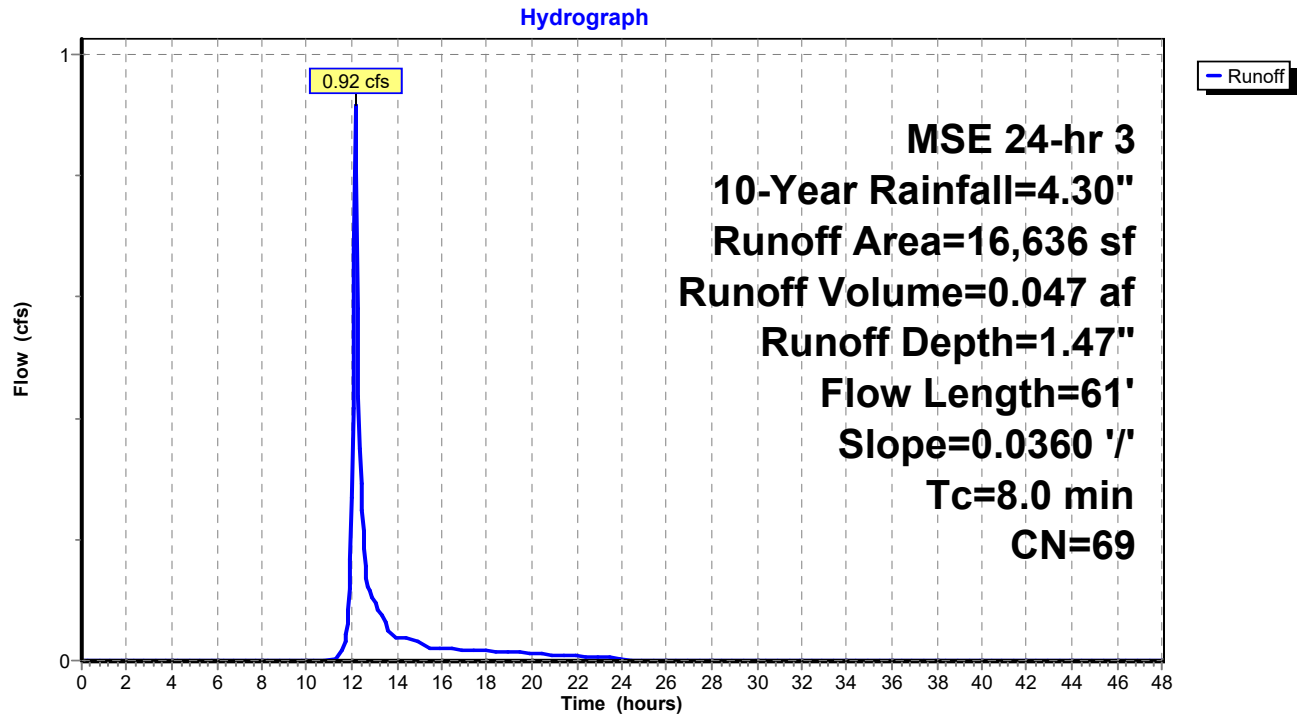
Runoff = 0.92 cfs @ 12.16 hrs, Volume= 0.047 af, Depth= 1.47"
Routed to Reach PWD : Proposed West (Clarence St) Discharge

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.30"

Area (sf)	CN	Description
3,626	98	Paved parking, HSG B
13,010	61	>75% Grass cover, Good, HSG B
16,636	69	Weighted Average
13,010		78.20% Pervious Area
3,626		21.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	61	0.0360	0.13		**Sheet Flow, North Sheet Flow** Grass: Dense n= 0.240 P2= 2.90"

Subcatchment DA1: DA-1 - West (Clarence St)



Summary for Subcatchment DA2: DA-2 - South (Frost Ave)

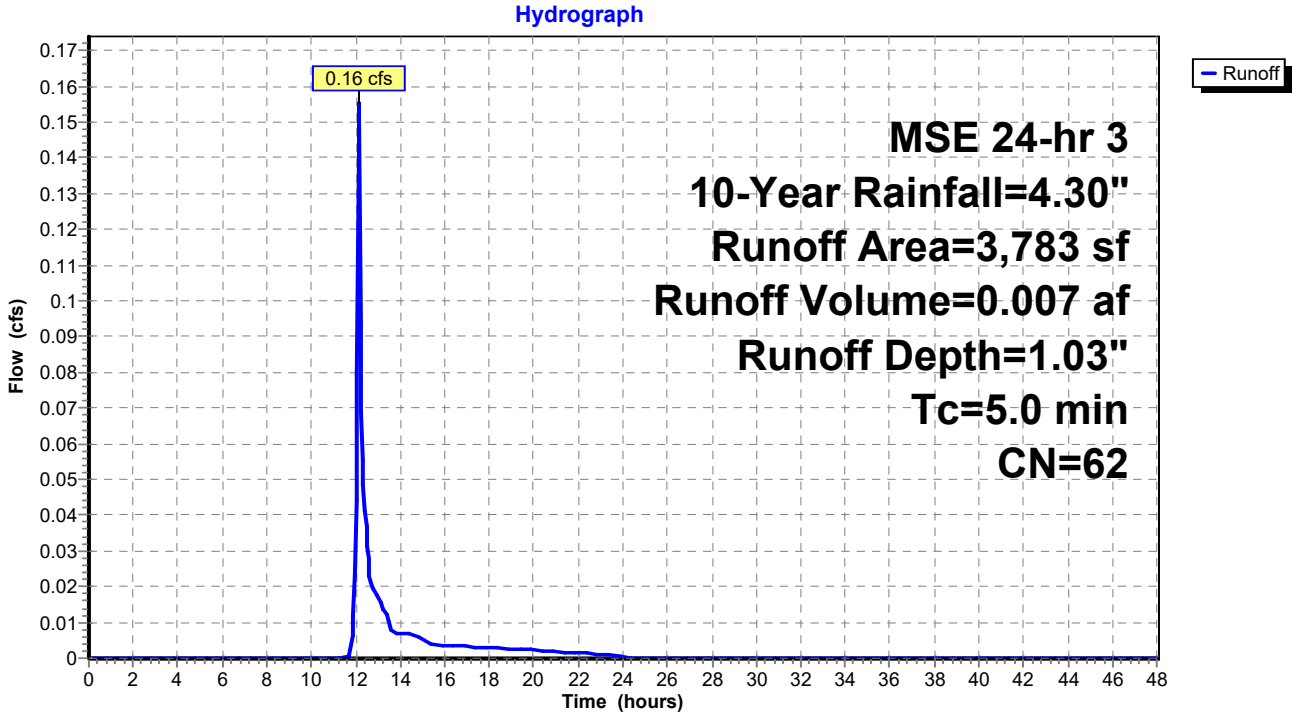
Runoff = 0.16 cfs @ 12.13 hrs, Volume= 0.007 af, Depth= 1.03"
Routed to Reach PD : Proposed Discharge

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.30"

Area (sf)	CN	Description
141	98	Paved parking, HSG B
3,642	61	>75% Grass cover, Good, HSG B
3,783	62	Weighted Average
3,642		96.27% Pervious Area
141		3.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Minimum ToC**

Subcatchment DA2: DA-2 - South (Frost Ave)



Summary for Subcatchment DA3: DA-3 - East (Ide St)

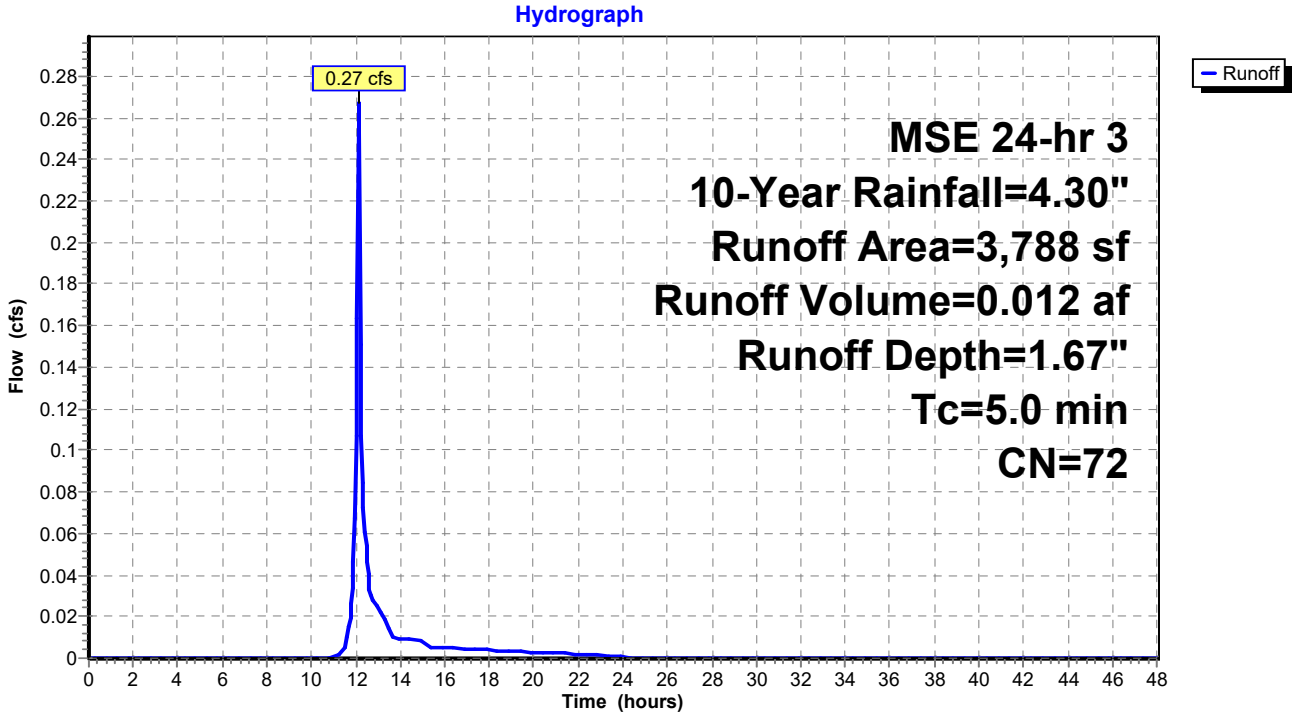
Runoff = 0.27 cfs @ 12.12 hrs, Volume= 0.012 af, Depth= 1.67"
Routed to Reach PD : Proposed Discharge

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.30"

Area (sf)	CN	Description
1,121	98	Paved parking, HSG B
2,667	61	>75% Grass cover, Good, HSG B
3,788	72	Weighted Average
2,667		70.41% Pervious Area
1,121		29.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Minimum ToC**

Subcatchment DA3: DA-3 - East (Ide St)



Summary for Subcatchment DA4: DA-4

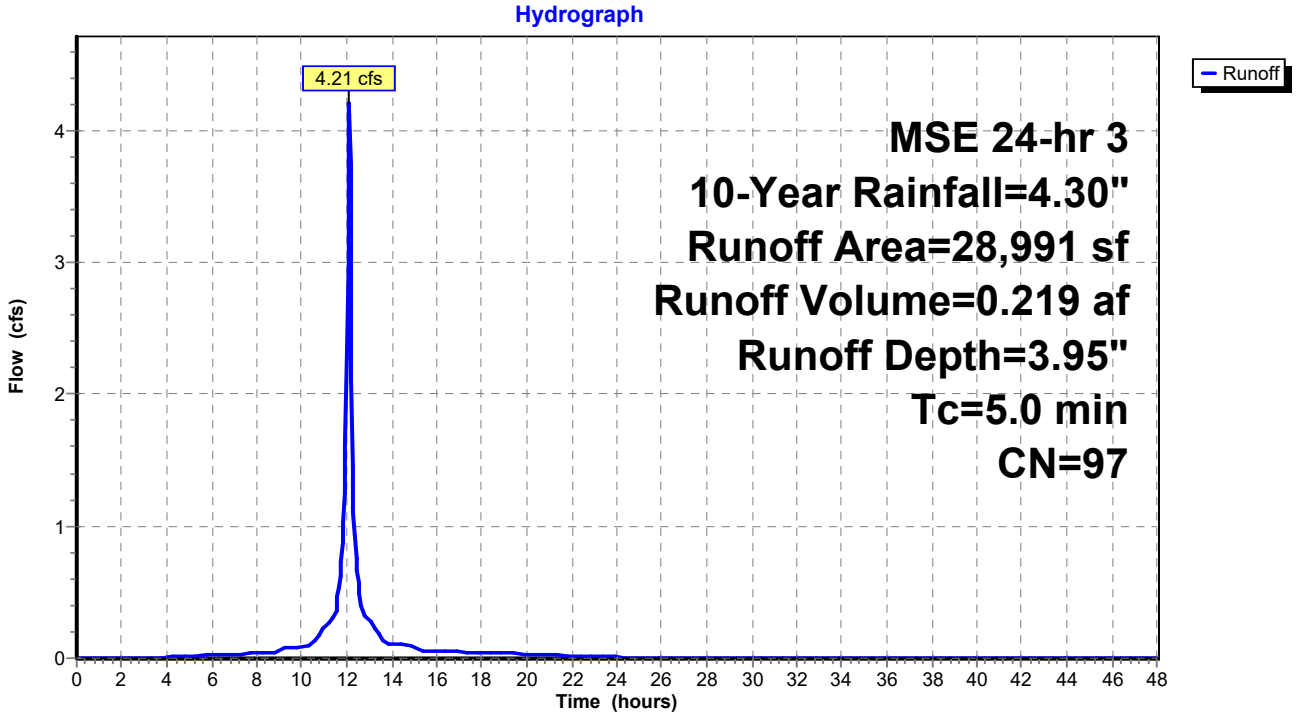
Runoff = 4.21 cfs @ 12.11 hrs, Volume= 0.219 af, Depth= 3.95"
Routed to Pond UDS : ADS Underground System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.30"

Area (sf)	CN	Description
28,588	98	Paved parking, HSG B
403	61	>75% Grass cover, Good, HSG B
28,991	97	Weighted Average
403		1.39% Pervious Area
28,588		98.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Minimum ToC**

Subcatchment DA4: DA-4

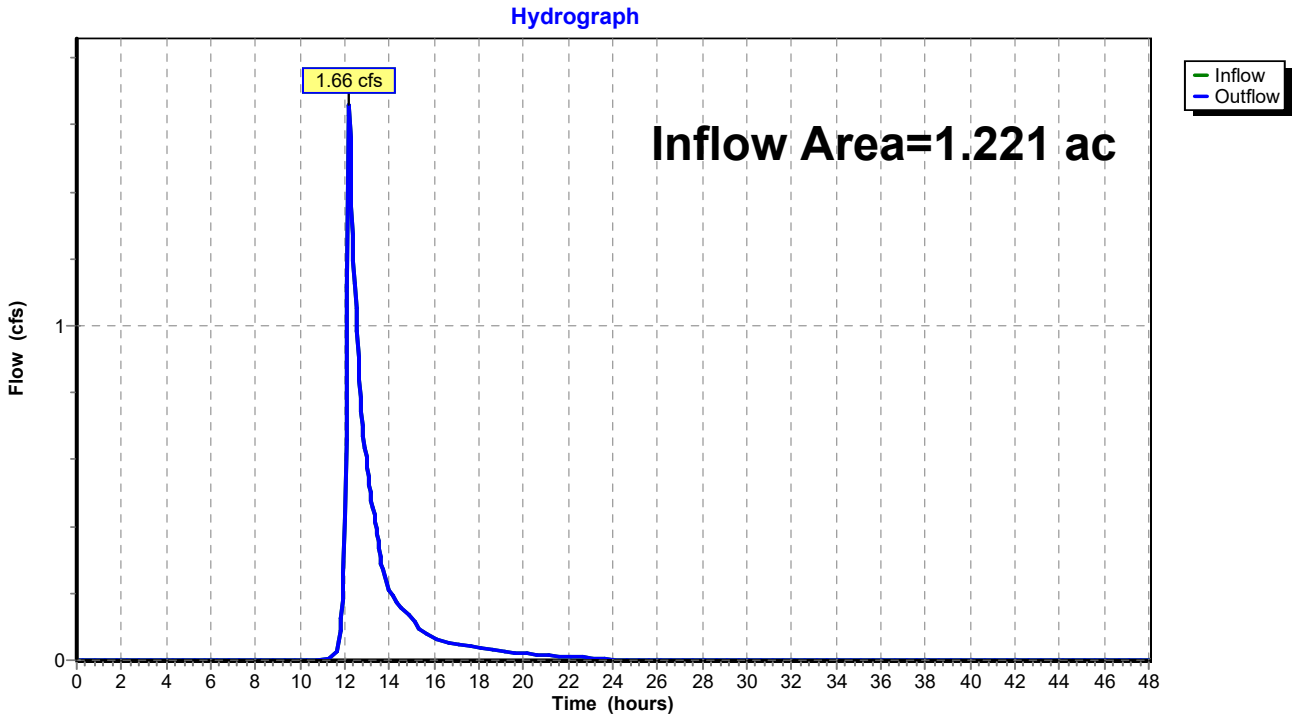


Summary for Reach PD: Proposed Discharge

Inflow Area = 1.221 ac, 62.93% Impervious, Inflow Depth = 1.51" for 10-Year event
Inflow = 1.66 cfs @ 12.18 hrs, Volume= 0.154 af
Outflow = 1.66 cfs @ 12.18 hrs, Volume= 0.154 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Reach PD: Proposed Discharge

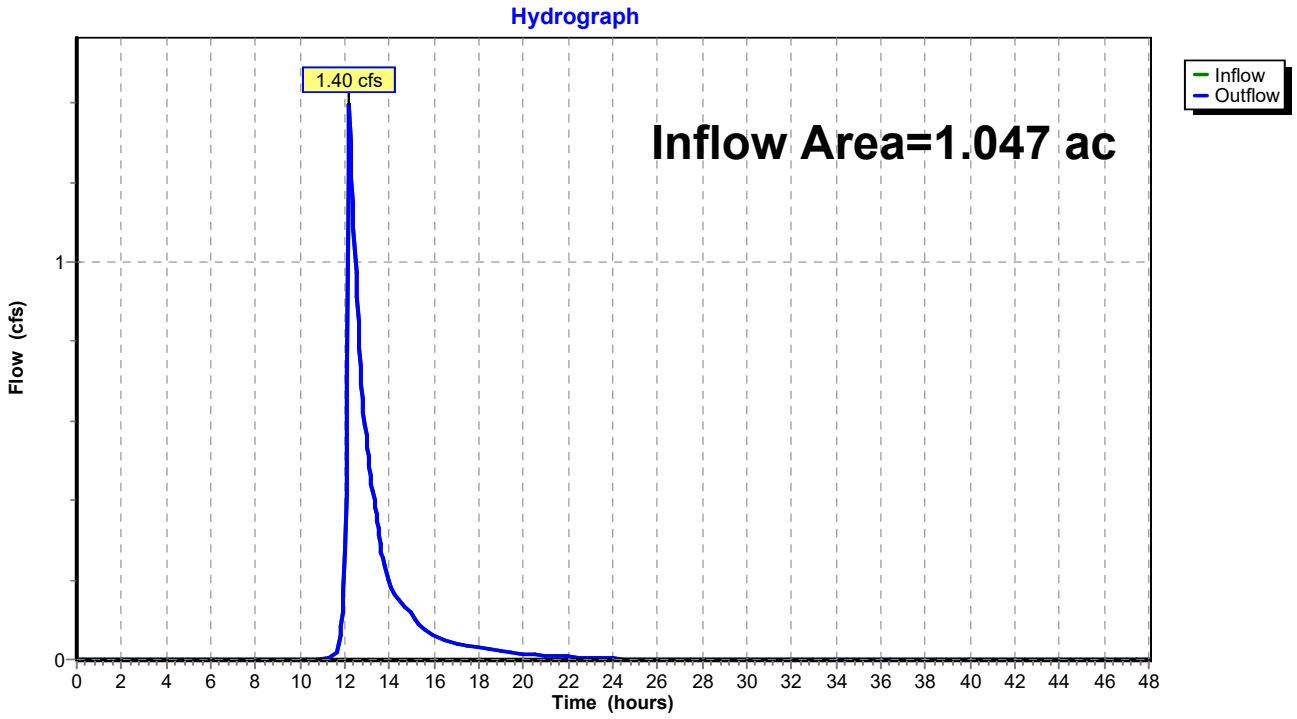


Summary for Reach PWD: Proposed West (Clarence St) Discharge

Inflow Area = 1.047 ac, 70.60% Impervious, Inflow Depth = 1.54" for 10-Year event
Inflow = 1.40 cfs @ 12.21 hrs, Volume= 0.134 af
Outflow = 1.40 cfs @ 12.21 hrs, Volume= 0.134 af, Atten= 0%, Lag= 0.0 min
Routed to Reach PD : Proposed Discharge

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Reach PWD: Proposed West (Clarence St) Discharge



Summary for Pond UDS: ADS Underground System

Inflow Area = 0.666 ac, 98.61% Impervious, Inflow Depth = 3.95" for 10-Year event
Inflow = 4.21 cfs @ 12.11 hrs, Volume= 0.219 af
Outflow = 0.84 cfs @ 12.38 hrs, Volume= 0.219 af, Atten= 80%, Lag= 15.9 min
Discarded = 0.04 cfs @ 9.75 hrs, Volume= 0.131 af
Primary = 0.80 cfs @ 12.38 hrs, Volume= 0.088 af
Routed to Reach PWD : Proposed West (Clarence St) Discharge

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 898.21' @ 12.38 hrs Surf.Area= 4,080 sf Storage= 4,927 cf

Plug-Flow detention time= 447.8 min calculated for 0.219 af (100% of inflow)
Center-of-Mass det. time= 448.7 min (1,201.7 - 752.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	896.45'	3,654 cf	**39.50'W x 103.30'L x 3.50'H Field A** 14,281 cf Overall - 5,145 cf Embedded = 9,135 cf x 40.0% Voids
#2A	896.95'	5,145 cf	**ADS_StormTech SC-740 +Cap** x 112 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 112 Chambers in 8 Rows
		8,799 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	897.65'	**12.0" Round Culvert** L= 20.6' Ke= 0.500 Inlet / Outlet Invert= 897.65' / 897.50' S= 0.0073 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	897.65'	**8.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	895.65'	**Custom Weir, Cv= 2.62 (C= 3.28)** Elev. (feet) 895.65 899.75 899.75 900.68 900.68 902.27 Width (feet) 0.00 0.00 4.00 4.00 2.00 2.00
#4	Discarded	896.45'	**0.450 in/hr Infiltration over Surface area**

Discarded OutFlow Max=0.04 cfs @ 9.75 hrs HW=896.51' (Free Discharge)
└**4=Infiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.80 cfs @ 12.38 hrs HW=898.21' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Passes 0.80 cfs of 0.90 cfs potential flow)
  ├**2=Orifice** (Orifice Controls 0.80 cfs @ 2.55 fps)
  └**3=Custom Weir** (Controls 0.00 cfs)

Pond UDS: ADS Underground System - Chamber Wizard Field A

Chamber Model = ADS_StormTechSC-740 +Cap (ADS StormTech®SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

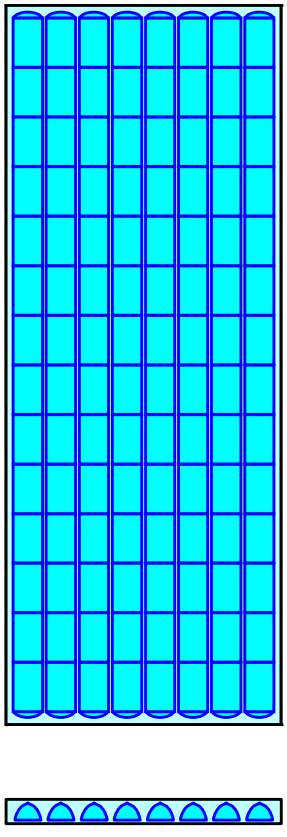
14 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 101.30' Row Length +12.0" End Stone x 2 = 103.30' Base Length
8 Rows x 51.0" Wide + 6.0" Spacing x 7 + 12.0" Side Stone x 2 = 39.50' Base Width
6.0" Stone Base + 30.0" Chamber Height + 6.0" Stone Cover = 3.50' Field Height

112 Chambers x 45.9 cf = 5,145.3 cf Chamber Storage

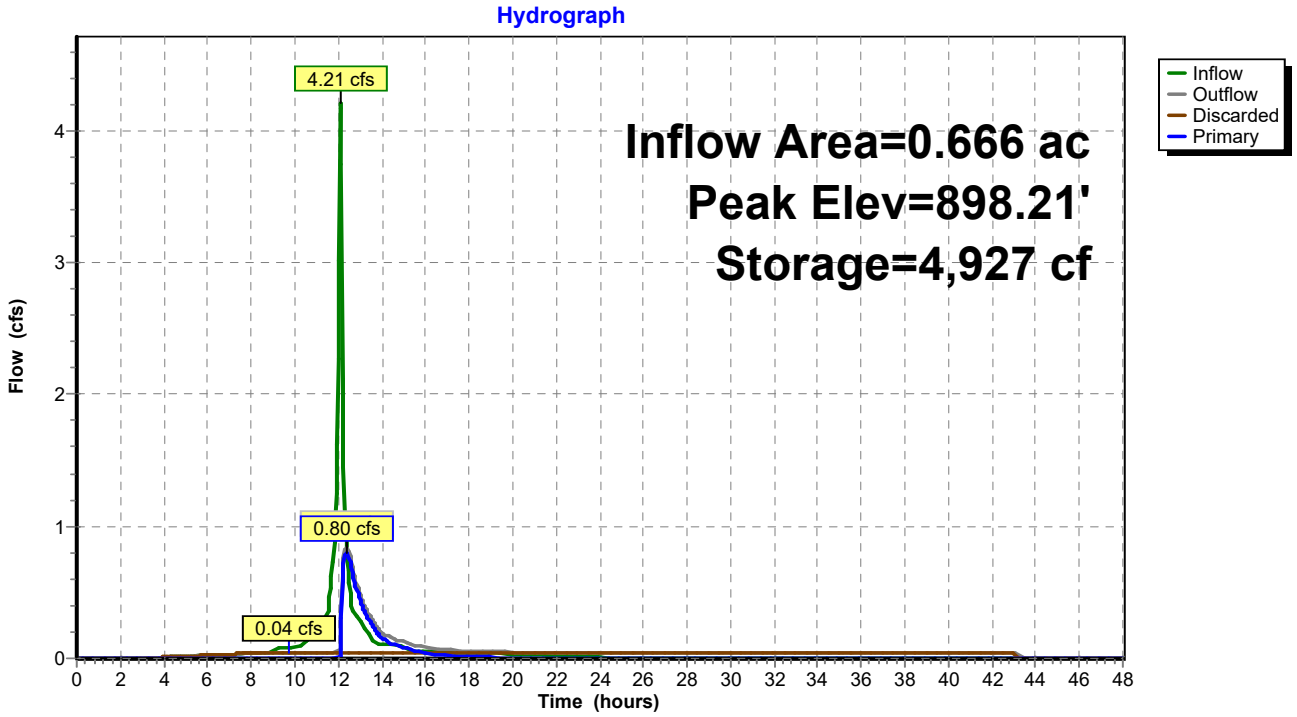
14,280.8 cf Field - 5,145.3 cf Chambers = 9,135.5 cf Stone x 40.0% Voids = 3,654.2 cf Stone Storage

Chamber Storage + Stone Storage = 8,799.5 cf = 0.202 af
Overall Storage Efficiency = 61.6%
Overall System Size = 103.30' x 39.50' x 3.50'

112 Chambers
528.9 cy Field
338.4 cy Stone



Pond UDS: ADS Underground System



Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment DA1: DA-1 - West (Clarence Runoff Area=16,636 sf 21.80% Impervious Runoff Depth=3.93"
Flow Length=61' Slope=0.0360 '/' Tc=8.0 min CN=69 Runoff=2.50 cfs 0.125 af

Subcatchment DA2: DA-2 - South (Frost Ave) Runoff Area=3,783 sf 3.73% Impervious Runoff Depth=3.17"
Tc=5.0 min CN=62 Runoff=0.51 cfs 0.023 af

Subcatchment DA3: DA-3 - East (Ide St) Runoff Area=3,788 sf 29.59% Impervious Runoff Depth=4.26"
Tc=5.0 min CN=72 Runoff=0.68 cfs 0.031 af

Subcatchment DA4: DA-4 Runoff Area=28,991 sf 98.61% Impervious Runoff Depth=7.14"
Tc=5.0 min CN=97 Runoff=7.41 cfs 0.396 af

Reach PD: Proposed Discharge Inflow=5.41 cfs 0.431 af
Outflow=5.41 cfs 0.431 af

Reach PWD: Proposed West (Clarence St) Discharge Inflow=4.36 cfs 0.377 af
Outflow=4.36 cfs 0.377 af

Pond UDS: ADS Underground System Peak Elev=899.57' Storage=8,177 cf Inflow=7.41 cfs 0.396 af
Discarded=0.04 cfs 0.144 af Primary=2.12 cfs 0.252 af Outflow=2.16 cfs 0.396 af

Total Runoff Area = 1.221 ac Runoff Volume = 0.575 af Average Runoff Depth = 5.65"
37.07% Pervious = 0.453 ac 62.93% Impervious = 0.769 ac

Summary for Subcatchment DA1: DA-1 - West (Clarence St)

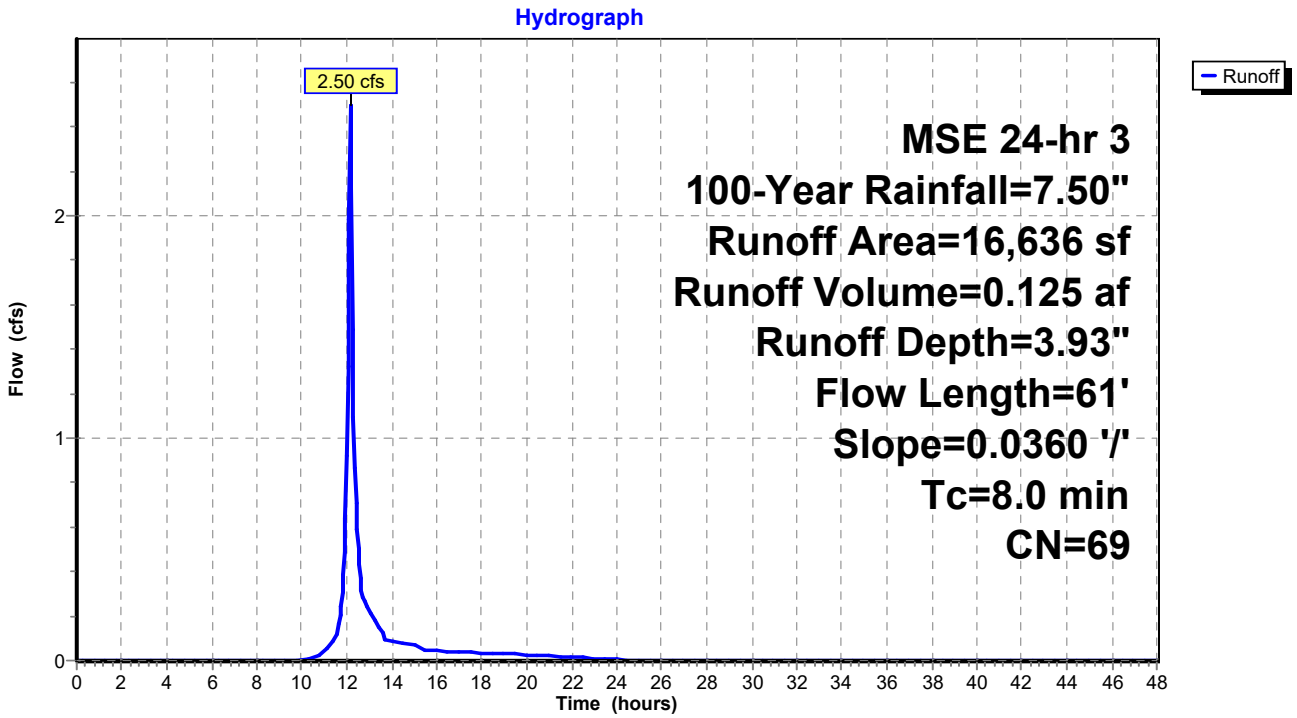
Runoff = 2.50 cfs @ 12.15 hrs, Volume= 0.125 af, Depth= 3.93"
Routed to Reach PWD : Proposed West (Clarence St) Discharge

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

Area (sf)	CN	Description
3,626	98	Paved parking, HSG B
13,010	61	>75% Grass cover, Good, HSG B
16,636	69	Weighted Average
13,010		78.20% Pervious Area
3,626		21.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	61	0.0360	0.13		**Sheet Flow, North Sheet Flow** Grass: Dense n= 0.240 P2= 2.90"

Subcatchment DA1: DA-1 - West (Clarence St)



Summary for Subcatchment DA2: DA-2 - South (Frost Ave)

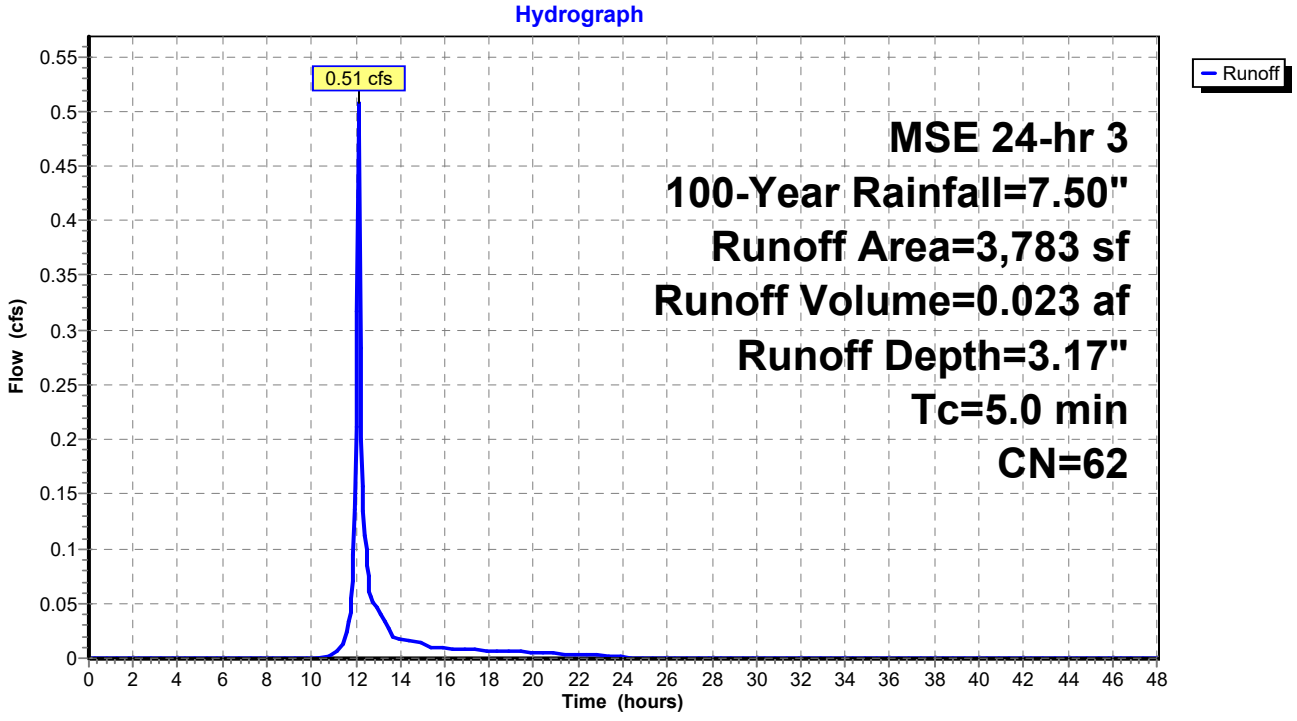
Runoff = 0.51 cfs @ 12.12 hrs, Volume= 0.023 af, Depth= 3.17"
Routed to Reach PD : Proposed Discharge

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

Area (sf)	CN	Description
141	98	Paved parking, HSG B
3,642	61	>75% Grass cover, Good, HSG B
3,783	62	Weighted Average
3,642		96.27% Pervious Area
141		3.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Minimum ToC**

Subcatchment DA2: DA-2 - South (Frost Ave)



Summary for Subcatchment DA3: DA-3 - East (Ide St)

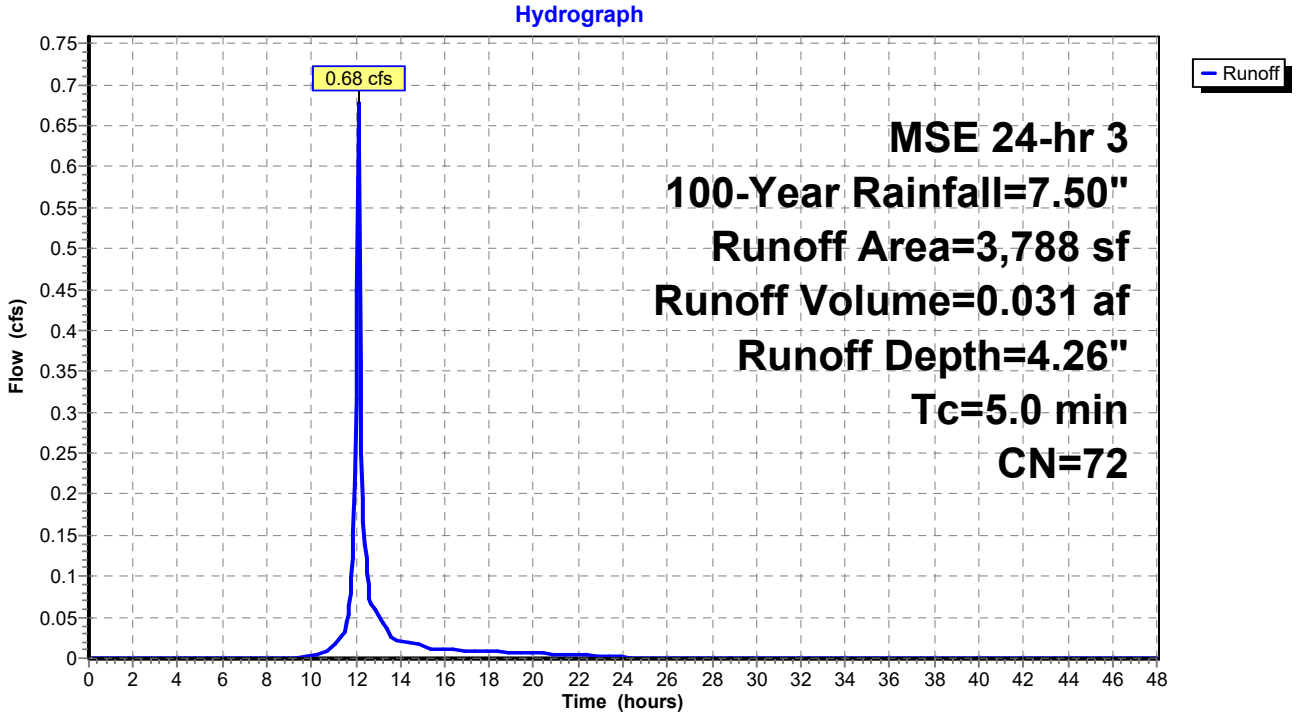
Runoff = 0.68 cfs @ 12.12 hrs, Volume= 0.031 af, Depth= 4.26"
Routed to Reach PD : Proposed Discharge

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

Area (sf)	CN	Description
1,121	98	Paved parking, HSG B
2,667	61	>75% Grass cover, Good, HSG B
3,788	72	Weighted Average
2,667		70.41% Pervious Area
1,121		29.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Minimum ToC**

Subcatchment DA3: DA-3 - East (Ide St)



Summary for Subcatchment DA4: DA-4

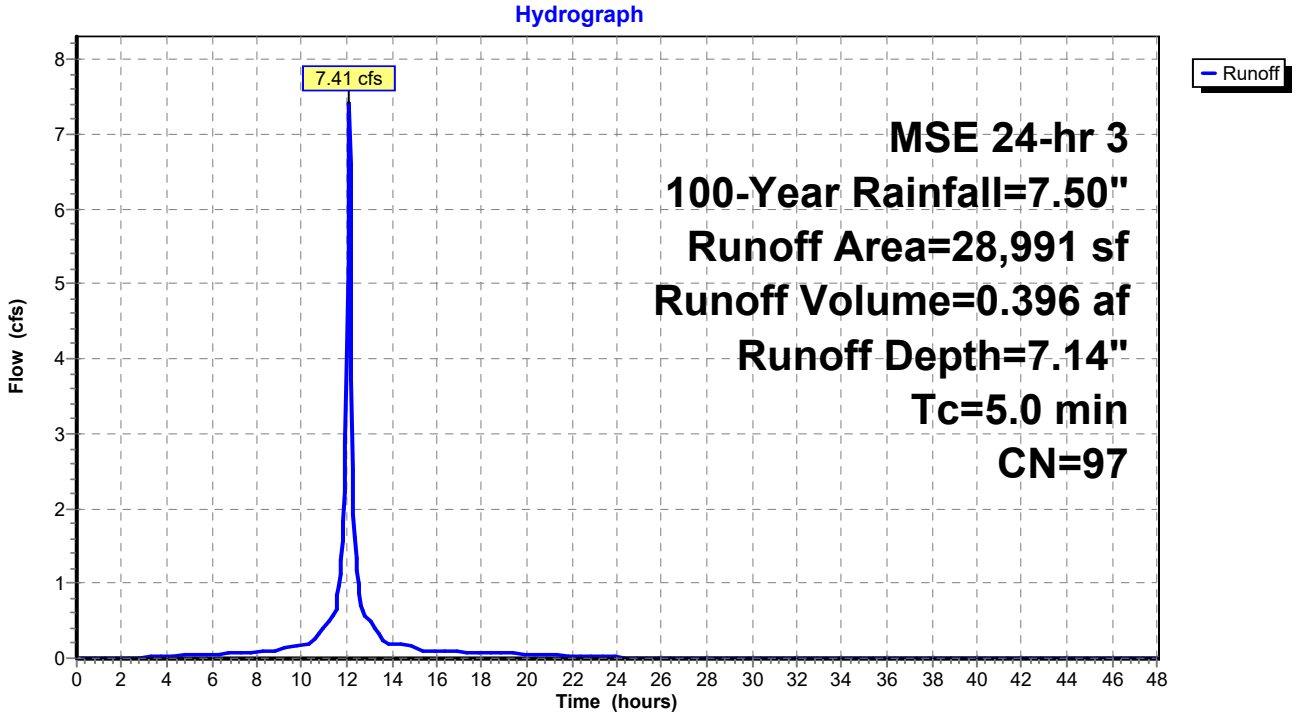
Runoff = 7.41 cfs @ 12.11 hrs, Volume= 0.396 af, Depth= 7.14"
Routed to Pond UDS : ADS Underground System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.50"

Area (sf)	CN	Description
28,588	98	Paved parking, HSG B
403	61	>75% Grass cover, Good, HSG B
28,991	97	Weighted Average
403		1.39% Pervious Area
28,588		98.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Minimum ToC**

Subcatchment DA4: DA-4

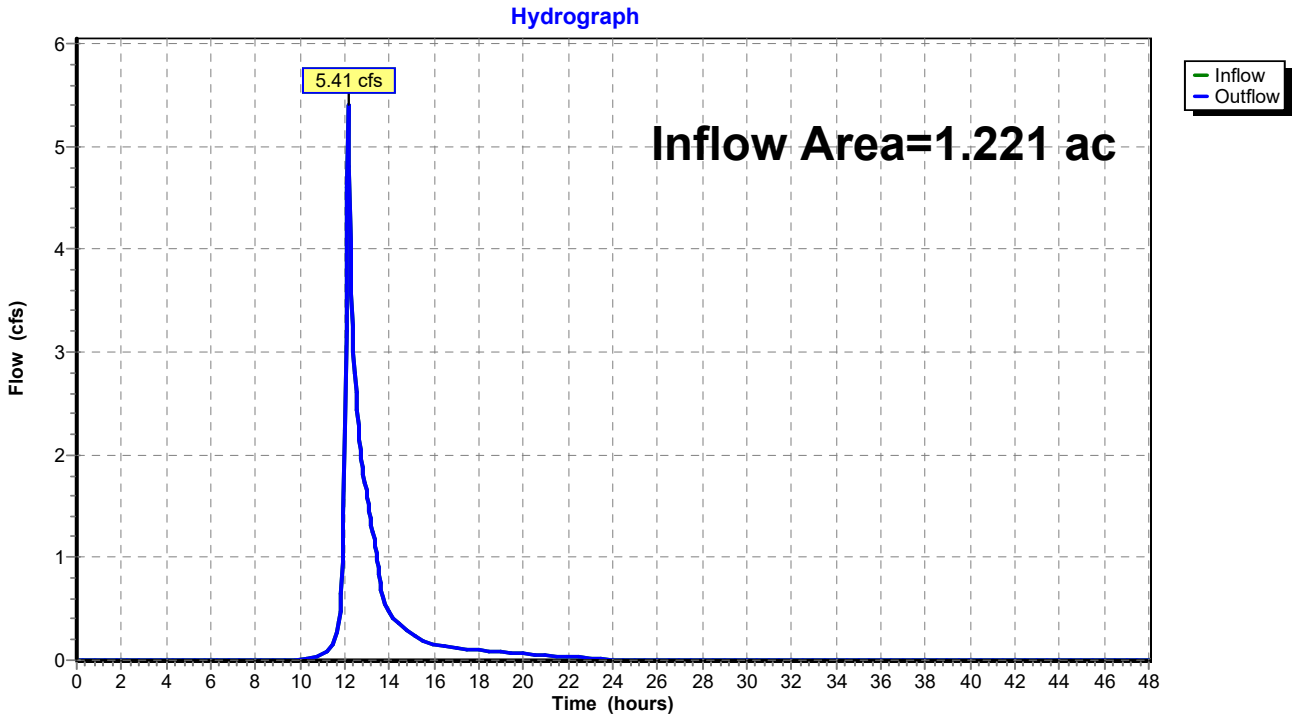


Summary for Reach PD: Proposed Discharge

Inflow Area = 1.221 ac, 62.93% Impervious, Inflow Depth = 4.23" for 100-Year event
Inflow = 5.41 cfs @ 12.15 hrs, Volume= 0.431 af
Outflow = 5.41 cfs @ 12.15 hrs, Volume= 0.431 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Reach PD: Proposed Discharge

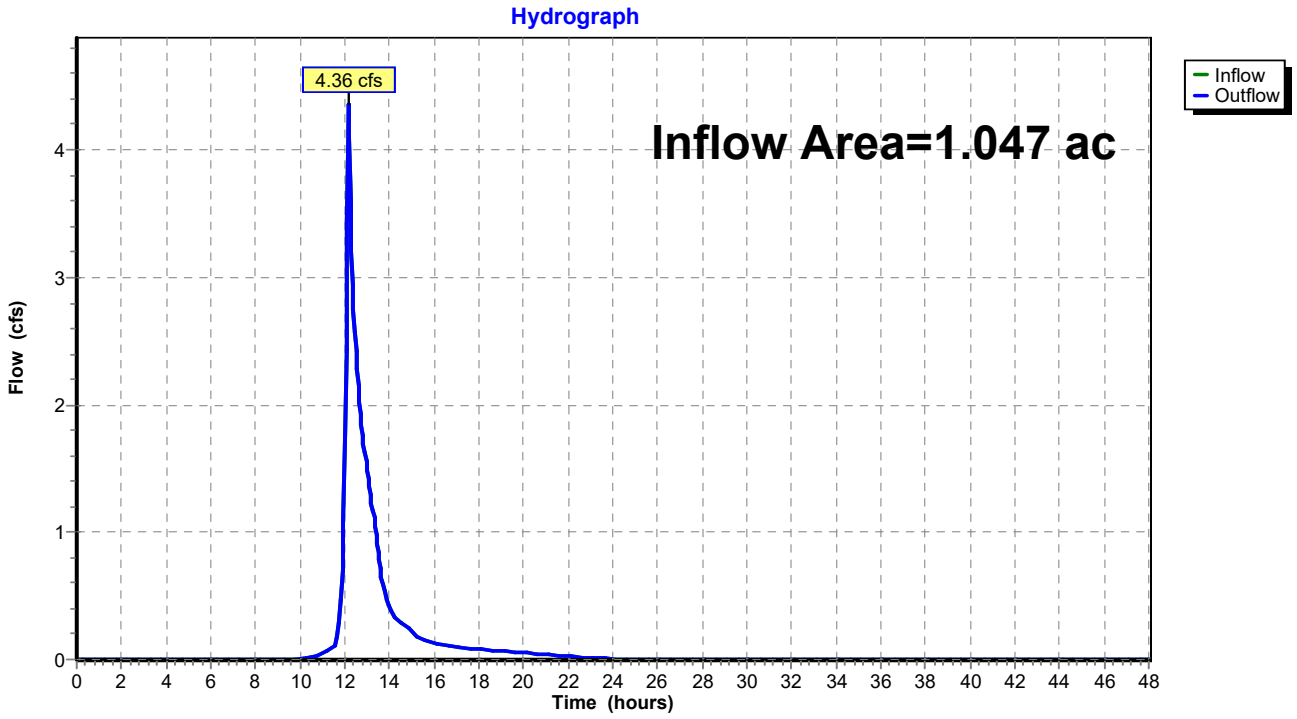


Summary for Reach PWD: Proposed West (Clarence St) Discharge

Inflow Area = 1.047 ac, 70.60% Impervious, Inflow Depth = 4.32" for 100-Year event
Inflow = 4.36 cfs @ 12.17 hrs, Volume= 0.377 af
Outflow = 4.36 cfs @ 12.17 hrs, Volume= 0.377 af, Atten= 0%, Lag= 0.0 min
Routed to Reach PD : Proposed Discharge

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Reach PWD: Proposed West (Clarence St) Discharge



Summary for Pond UDS: ADS Underground System

Inflow Area = 0.666 ac, 98.61% Impervious, Inflow Depth = 7.14" for 100-Year event
Inflow = 7.41 cfs @ 12.11 hrs, Volume= 0.396 af
Outflow = 2.16 cfs @ 12.28 hrs, Volume= 0.396 af, Atten= 71%, Lag= 10.3 min
Discarded = 0.04 cfs @ 7.15 hrs, Volume= 0.144 af
Primary = 2.12 cfs @ 12.28 hrs, Volume= 0.252 af
Routed to Reach PWD : Proposed West (Clarence St) Discharge

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 899.57' @ 12.28 hrs Surf.Area= 4,080 sf Storage= 8,177 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 294.9 min (1,039.2 - 744.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	896.45'	3,654 cf	**39.50'W x 103.30'L x 3.50'H Field A** 14,281 cf Overall - 5,145 cf Embedded = 9,135 cf x 40.0% Voids
#2A	896.95'	5,145 cf	**ADS_StormTech SC-740 +Cap** x 112 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 112 Chambers in 8 Rows
		8,799 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	897.65'	**12.0" Round Culvert** L= 20.6' Ke= 0.500 Inlet / Outlet Invert= 897.65' / 897.50' S= 0.0073 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	897.65'	**8.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	895.65'	**Custom Weir, Cv= 2.62 (C= 3.28)** Elev. (feet) 895.65 899.75 899.75 900.68 900.68 902.27 Width (feet) 0.00 0.00 4.00 4.00 2.00 2.00
#4	Discarded	896.45'	**0.450 in/hr Infiltration over Surface area**

Discarded OutFlow Max=0.04 cfs @ 7.15 hrs HW=896.51' (Free Discharge)
└**4=Infiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=2.11 cfs @ 12.28 hrs HW=899.56' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Passes 2.11 cfs of 4.44 cfs potential flow)
  ├**2=Orifice** (Orifice Controls 2.11 cfs @ 6.05 fps)
  └**3=Custom Weir** (Controls 0.00 cfs)

Pond UDS: ADS Underground System - Chamber Wizard Field A

Chamber Model = ADS_StormTechSC-740 +Cap (ADS StormTech®SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

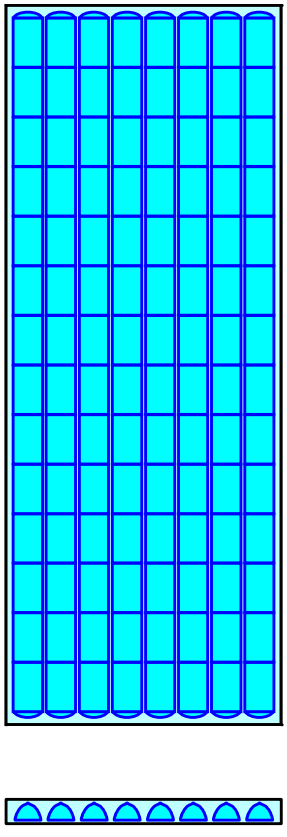
14 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 101.30' Row Length +12.0" End Stone x 2 = 103.30' Base Length
8 Rows x 51.0" Wide + 6.0" Spacing x 7 + 12.0" Side Stone x 2 = 39.50' Base Width
6.0" Stone Base + 30.0" Chamber Height + 6.0" Stone Cover = 3.50' Field Height

112 Chambers x 45.9 cf = 5,145.3 cf Chamber Storage

14,280.8 cf Field - 5,145.3 cf Chambers = 9,135.5 cf Stone x 40.0% Voids = 3,654.2 cf Stone Storage

Chamber Storage + Stone Storage = 8,799.5 cf = 0.202 af
Overall Storage Efficiency = 61.6%
Overall System Size = 103.30' x 39.50' x 3.50'

112 Chambers
528.9 cy Field
338.4 cy Stone



Pond UDS: ADS Underground System